United States Military Academy

West Point, New York 10996

A Simulation-Based Methodology for Developing a Standardized Design Template for Future Battle Command Training Centers

OPERATIONS RESEARCH CENTER OF EXCELLENCE
TECHNICAL REPORT #DSE-TR-0603
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Approved by
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Professor and Head, Department of Systems Engineering

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Abstract

Army transformation and the digitization of the force have, in many ways, revolutionized how the Army executes battle command. This has induced a re-evaluation of Battle Command Training Centers (BCTCs) and the capabilities they possess to achieve battle command training strategies and objectives.

Current BCTC facilities were developed within the last 6-7 years to address the unique training needs of newly formed digitized units (Stryker Brigade Combat Teams and units involved in the Advanced Warfighting Experiment or AWE) at a handful of installations. In the interim, the Army has decided to digitize the entire force. This has generated logical questions about whether existing facilities can accommodate this shift and the evolving and growing training needs of the transforming force, as well as what capabilities future facilities must possess to meet these needs for the foreseeable future. To this point, little rigor has been applied to verify the answers to such questions and validate design templates for future facilities. In order to rectify this problem, the Army has implemented efforts to develop and design a standardized BCTC design template that provides the battle command training capability necessary to achieve expected annual training throughput and battle command training objectives.

We utilized the Systems Engineering and Management Process (SEMP) taught in the Department of Systems Engineering at West Point as the overarching approach to addressing the Army's problem. Specifically, we applied the first three phases of the SEMP 1) to thoroughly and completely define the problem through an in-depth needs analysis and functional decomposition of the system, which would facilitate the development of base-case designs; 2) to develop a simulation-based approach to modeling the base-case designs in order to assess the adequacy of the training capabilities they possessed and then evaluate alternative configurations; and then 3) to provide recommended templates to the Army that possess the requisite capabilities to achieve annual training objectives.

The core of our efforts revolved around the central question concerning the adequacy of the training capabilities inherent in the base-case designs. As this paper will show, the results clearly indicate that the capabilities are indeed adequate to achieve annual training throughput

objectives as they pertain to the Army's Digital Training Strategy, the Combined Arms Training Strategy, and the Army Force Generation Model. Although the base-case designs appear to be excessive relative to the results of our modeling and analysis process, we recommend them nevertheless for several reasons that stem from the flexibility they provide.

In the end, this paper will provide a detailed perspective on our problem-solving methodology, our simulation-based approach therein, and the results we achieved. Additionally, it will show how our efforts generated an analytical tool that the Army can use to assist in the design and development of training facilities to ensure they possess the capabilities required of them, as well as a simulation tool that can identify the potential impacts on training as a result of changes that run the gamut from space and staff levels to changes in training requirements to the unit composition on a particular installation.

About the Authors

Major Gregory L. Boylan is an Assistant Professor in the Department of Systems Engineering and Analyst in the Operations Research Center at the United States Military Academy (USMA) at West Point. He is an Infantry officer and has served in various positions, including platoon leader, company executive officer, staff officer and company commander. He holds a B.S. in Environmental Science from USMA, May 1994, and an M.S. in Industrial Engineering from the Georgia Institute of Technology, May 2003. MAJ Boylan may be contacted at gregory.boylan@us.army.mil.

Lieutenant Colonel Simon R. Goerger is an Associate Professor in the Department of Systems Engineering at the United States Military Academy, West Point, New York. He earned his Bachelor of Science from the United States Military Academy in 1988 and his Masters in Computer Science and Doctorate in Modeling and Simulations from the Naval Postgraduate School, Monterey, CA in 1998 and 2004, respectively. His research interests include combat models, agent based modeling, human factors, and training in virtual environments. LTC Goerger has served as an infantry officer with the 6th Infantry Division in Alaska & Sinai, Egypt, as a cavalry officer with the 2^{d} Armored Cavalry Regiment at Fort Polk, LA & Port-au-Prince, Haiti, and as a software engineer for COMBAT^{XXI}, the US Army's future brigade and below analytical model for the 21st Century. LTC Goerger may be contacted at simon.goerger@usma.edu.

Acknowledgements

This study was funded by the Battle Command, Simulation, and Experimentation Directorate (BCSE) based on the proposal entitled "Warfighting Centers Capabilities, Layout, and Design" and was completed in May 2006.

We would like to acknowledge the contribution and support of several individuals. LTC Favio Lopez of the BCSE Directorate was directly responsible for bringing the ORCEN into this project and provided us with an assortment of points of contact and information with which to pursue a solution to this problem. Specifically, all members of the Battle Command Training Center Design Board and Working Group listed below played an instrumental role in developing our knowledge and understanding of BCTCs and their functional requirements. Their efforts in developing staffing and training metrics provided us with the mathematical foundation for our work, without which we would not have achieved our results in the time that we did. The BCTC Working Group consisted of the following individuals from various organizations:

Organization	Individuals
HQDA G-3 (DAMO-TRS)	LTC Darran Anderson, MAJ Doug Newcomb
National Simulation Center/TCID	Mr. Dan Buchberg, Mr. Jim Clary, Mr. Bob Thompson
CAC-T/CTD	Mr. Dave Bowman, Mr. Bryan Sampson, Mr. Dave Mitchell
USACE, Huntsville District	Mr. Mark Fleming, Mr. Jim Kelley
PEO STRI	Mr. Hoyle Cook
FORSCOM	Mr. Terry Murphy
I Corps & Fort Lewis BCTC	SGM Randall Johnston
III Corps & Fort Hood	Tom Christopherson, Randy Ruhl
XVIII Abn Corps & Fort Bragg	Mr. Randy Glass, Ms. Ruth Muller
USAREUR	Mr. Thomas Lasch
USARAK	LTC Mark Boyd

Additionally, we would like to acknowledge the contributions and expertise provided by members of the Construction Engineering Research Laboratory (CERL) in Champaign, IL. These individuals include Mr. Mike Case, Ms. Beth Brucker, and Ms. Susan Natchigall. Their collective knowledge and expertise were invaluable in the development of the two and three-dimensional renditions of the final design recommendation.

Our mention of these contributors does not imply their approval of our results. The opinions contained herein are the opinions of the authors and do not necessarily reflect those of the BCSE Directorate, the United States Military Academy, the United States Army, or the Department of Defense.

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Chapter 1: Introduction

1.1 General

The Army requires a standardized design template for the development of future Battle Command Training Centers (BCTC) that provides adequate capabilities to train the force and achieve the Army Digital Training Strategy (ADTS), the Combined Arms Training Strategy (CATS), and the recently developed Army Force Generation (ARFORGEN) model. These facilities must be robust enough to accommodate the full spectrum of training across all echelons of the force. This includes day-to-day individual level training on the growing numbers of digital command, control, communications, computers, and intelligence (C4I) systems all the way up through Corps and Joint-level Warfighter Exercises (WFX) that integrate live training with large scale constructive simulations and require interoperability between multiple facilities across multiple continents.

To this point, BCTCs have been developed and designed independently of each other and tailored to the needs of specific unit types that were designated as “digitized units”. For a few installations, this has resulted in new facilities intended for use by one or two digitized brigades, typically Stryker Brigades. However, within the last five years, the Army has decided to digitize the entire force, indicating that facilities originally designed to support one or two Stryker Brigades would now need to support all digital force components on installations.

In conjunction with the BCTC Working Group and Design Board with which we worked, we believe that the Army requires a solid needs-based analysis coupled with a rigorous Operations Research (OR) approach that will 1) identify the precise functional requirements necessary to achieve live, virtual, and constructive training objectives and 2) validate those requirements and the metrics used to develop them. From there, we can develop and design facilities that possess the requisite core training capability to meet those requirements and achieve the Army’s training strategies and goals. In this report, we discuss our approach, beginning with a description of the problem background and the methodology we used. We will discuss some of the work of the BCTC Working Group relative to the metrics and functional requirements developed for the standardized design template, as well

as the preliminary, or base case design templates that resulted. We will then delineate our findings and results in detail, focusing on our simulation-based approach to assessing the adequacy of the training capability provided by the base cases and recommending modifications to them. Finally, we will conclude with our recommendation to the BCTC Working Group and the BCSE for creating standardized templates that will meet the Army's needs.

1.2 Background

1.2.1. SMART

Since the mid 1990's, the Army has emphasized the increased integration of modeling and simulation (M&S) into the systems design and acquisition process. Initially referred to as simulation-based acquisition, this effort is now part of the Simulation and Modeling for Acquisition, Requirements, and Training (SMART) program. The SMART program purports "rapid prototyping using M&S [modeling and simulation] media to facilitate systems engineering so that materiel systems meet users' needs in an affordable and timely manner while minimizing risk (Army Model and Simulation Office, 2002)." It represents the Army's initiative to exploit the advantages of M&S to improve effectiveness and efficiency in, among other things, developing and designing systems, as well as testing and evaluating them in terms of supportability and affordability (Army Model and Simulation Office, 2002). With this initiative come the challenges of identifying and developing opportunities to exercise it.

1.2.2. The Battle Command, Simulation, and Experimentation Directorate

As the overseer of the SMART Program, the Battle Command, Simulation, and Experimentation (BCSE) Directorate faces such challenges. The BCSE directorate, a unique branch within the G-3 Section of the Army Staff (HQDA – Headquarters, Department of the Army), is the Army's "focal point to integrate, analyze, prioritize, synchronize, and standardize Battle Command from concept and O&O [operational and organizational] development through doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) recommendations (BCSE, 2006)." This includes many

different aspects of the use virtual and constructive simulations in training and extends to the facilities earmarked as the nucleus of battle command training on installations. The directorate operates four subordinate branches, divided by the respective areas for which the directorate acts as the Army's proponent. See Figure 1.1 below.

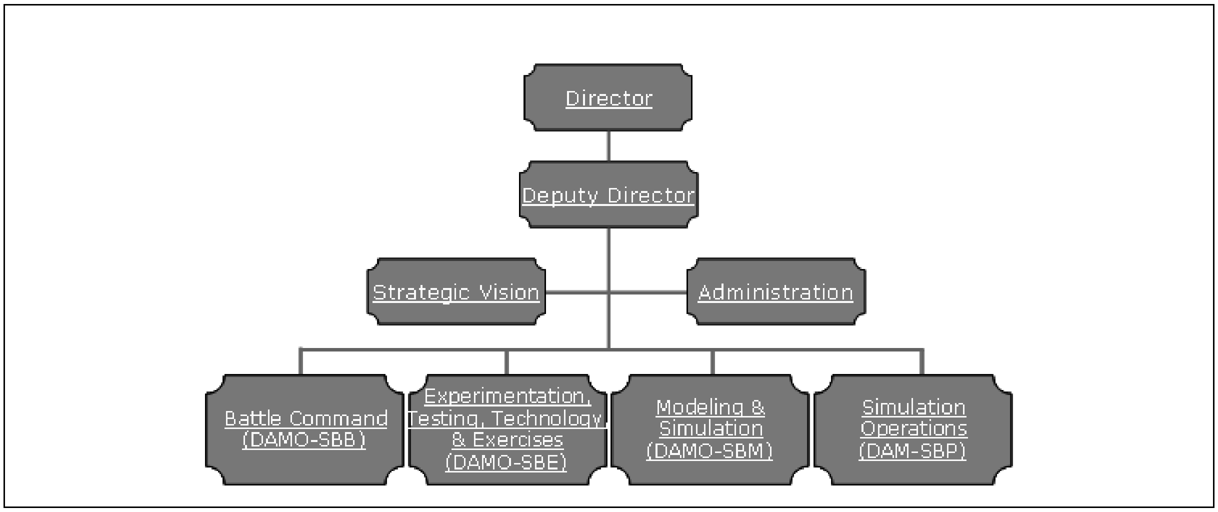

Figure 1.1. BCSE Directorate organizational chart reflecting the four subordinate branches within the organization.

Although the four sub-branches have different focus areas within the directorate, they are united by the means with which they are implemented: battle command training and the facilities that enable it. Accordingly, a current focus of the BCSE Directorate, and the impetus of this project, is to work with other branches within the HQDA G-3 to develop a standardized design template for the Army's future BCTCs.

1.2.3. Battle Command Training Centers

Battle Command Training Centers grew out of the initial efforts to transform the Army in the mid to late 1990's, beginning with the Advanced Warfighting Experiement at Fort Hood, TX. Appendix B of the Army Digital Training Strategy describes BCTCs as

> *Facilit[ies] that [have] the capability to conduct training on digital C4ISR systems, and connects to all training environments, all domains, all levels, and to any training audience. Depending upon specific site requirements, the number of persons/units to be trained, and access to a similar type capability, a BCTC facility will be tailored in size and structure ranging from a digitalized classroom to a separate stand alone facility. It contains the capability to communicate digitally, "reach," with other installations, simulation centers, and centralized databases…* (U.S. Army Combined Arms Center (CAC) – Collective Training Directorate (CTD), 2005)*"*

In short, these facilities represent probably the singularly most cost-efficient means of supporting the training of digital systems, as well as providing units with the ability to more fully train on their mission essential tasks across the full spectrum of space and operations in which they are to execute them. Specifically, BCTCs are expected provide the training capability elements listed in the following table.

Table 1. Training capability elements expected of Battle Command Training Centers.

Training	• "Near" turn-key training. • Digital Battle Staff training on demand. • Frequency according to commander's training strategy. • Training from operator to decision maker level training. • Digital Leader Training. • Dedicated subject matter experts.
Infrastructure	• Facilitation of future enhancement • Immersion in developing War fighting (Virtual Portal). • Expertise to the training development community and to units at Home Station and deployed. • Expertise to provide exercise design, and exercise support. • Simulation/stimulation driven.
Deployment Preparation	• Reach Operations • Battlefield visualization. • Mission prep; mission rehearsal • Course of Action development and analyses capability

Any BCTC must, at a minimum, possess the capability to support the number of units based at that installation. This translates to minimum space, staff, and equipment capabilities required to support various training events, whether they are daily individual classroom-based events or multi-day/week collective training exercises.

1.3 Overall Problem-Solving Methodology

We based our overarching methodology on the Systems Engineering and Management Process (SEMP), which is taught in the Department of Systems Engineering at the United States Military Academy. The SEMP is a four-phased iterative process, depicted in Figure 1.2 below, that facilitates refinements to any products based upon new information or discoveries regardless of where in the process the discoveries occur. It has been successfully applied in an assortment of projects for the Army, from identifying a simulation to support acquisition decision making (Tollefson et al., 2004) to designing a simulation architecture (Henderson and Wolter) to determining the best regional structure for the

Installation Management Agency (Trainor, et al., 2004). What follows is a condensed overview of how this process works in the broader context of solving problems, as well as how we adapted it to our particular problem. Since we will focus more on the latter, a more detailed discussion of the SEMP is available in (Tollefson et al., 2004).

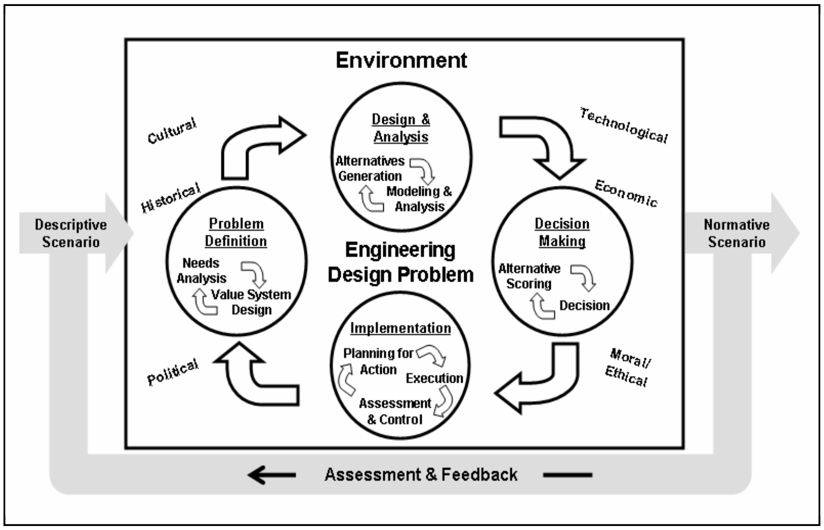

Figure 1.2. Systems Engineering and Management Process (McCarthy, et al., 2003).

The first phase is Problem Definition, comprised of Needs Analysis and Value System Design. The Needs Analysis begins with an initial problem statement from the client. Using various tools and techniques, we seek to convert that initial problem statement into a revised statement that more accurately articulates the client's true need. With an accurate revised problem statement, the project progresses into Value System Design. Here, we use value-focused thinking to transform the required functions of the system into objectives and associated evaluation measures. The resulting value system represents the values of the primary stakeholders and provides a basis to evaluate future alternative solutions to the problem of interest.

Pursuant to defining the underlying need and determining the associated system requirements, we transition to the Design and Analysis phase, wherein we generate potential alternative solutions to the problem and then determine ways in which to model and analyze those alternatives in order to ascertain the degree to which they meet the requirements.

Following the above analysis, we move into the Decision-Making phase of the SEMP. Here, we use the value hierarchy to compare the alternatives. Then, with the results

of the comparison, a thorough sensitivity analysis, and a cost-benefit analysis, we are able to recommend a design (or more specifically, capability) template alternative.

The fourth and final phase, pending acceptance of the recommendation, is Implementation. Implementation consists of three steps – Planning for Action, Execution, and Assessment and Control. Any proposed implementation plan will include, at a minimum, 1) a phased timeline that identifies intermediate objectives, essential tasks, and the critical path, 2) an estimation of the required implementation and life-cycle costs associated with the solution, and 3) other assessment and control mechanisms to help manage the plan.

We should note here that we were incorporated into a much larger effort in order to play a fairly specific analytical role aimed at bringing more rigorous approaches to bear where previously there had been little or none. Accordingly, and as this report will show, our efforts concentrated on the first three phases discussed above. Pursuant to our recommendation, the parent effort (what we will introduce later as the BCTC Working Group and Design Board) would then incorporate the results of our analysis into its design template recommendations, which it would then present to the actual senior decision maker, which is the Army G-3. The following figure depicts a more detailed view of how we applied the SEMP in our specific piece of this problem.

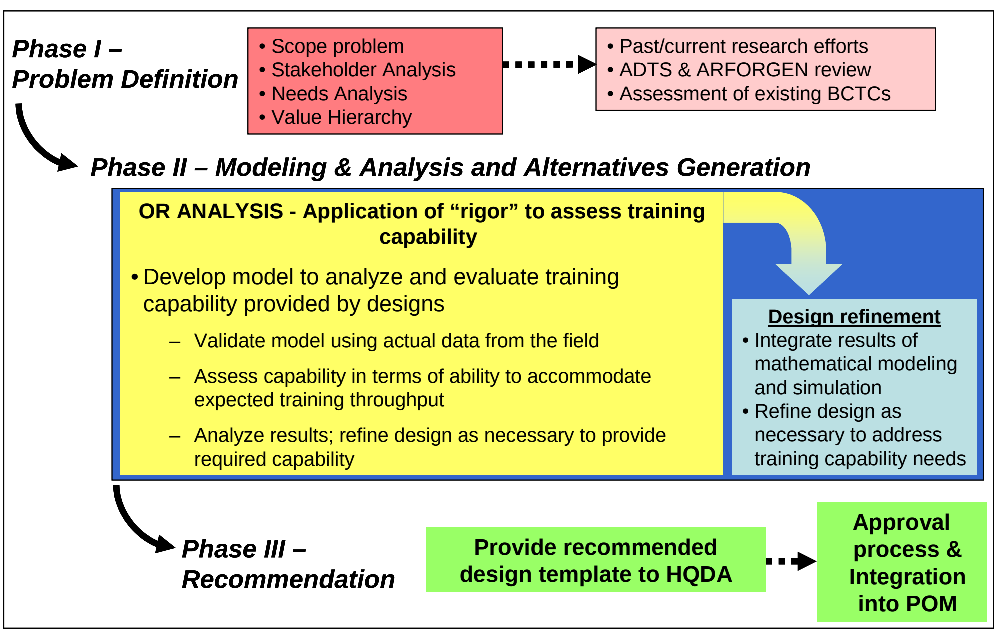

Figure 1.3. Detailed adaptation of Phases I-III of the SEMP, which reflects the specific manner in which they were applied in the context of the problem.

Chapter 2: Problem Definition

2.1 Overview

Over the course of defining the problem, we conducted a series of critical steps pursuant to obtaining the initial, unrefined problem statement from our client. These included a system decomposition, stakeholder analysis, literature review, and functional analysis. All of this led to the development of a revised or refined problem statement and a transition to value-focused thinking. We devote this chapter to a detailed explanation of how we executed this particular phase of the SEMP.

2.2 Needs Analysis

2.2.1. Initial Problem Statement

Based upon discussions with COL Stone and his staff at the BCSE Directorate during our initial project meeting on 1 September, 2005, we obtained the following initial problem statement:

> *The Battle Command, Simulation, and Experimentation (BCSE) Directorate requires the development of a standardized Battle Command Training Center template that possesses a baseline set of capabilities and is designed to accommodate all individual and collective digital and command post training.*

2.2.2. System Decomposition

We began our problem-solving approach by considering the BCTC system in general and decomposing it into its primary components, functions, and hierarchical structure. This initial look at the system enhanced our understanding of the BCTC, allowed us to consider its key aspects, and served as a starting point from which to launch our analysis.

According to the ADTS, the primary function of a BCTC is to support the execution of the Army's digital and combined arms training strategies. This central function decomposes to two primary sub-functions: 1) provide training capability for supporting all individual, staff, leader and unit digital and battle command training within an installation's footprint and 2) provide peripheral capability to support all administrative and life support functions

required by the first. A more detailed analysis of these functions and sub-functions will follow later in this report.

We can divide the components of any system into three types: structural, operating, and flow. Structural components denote the static elements of the system that remain unchanged as the system performs its functions. For a BCTC, the structural components consist of the actual physical space that comprises it. These are the spaces developed and allocated to perform both training and administrative functions. The operating components are the dynamic elements of the system that perform the processing within the system. Primary examples for a BCTC include the various categories of staff, as well as the hardware/software elements and networks. Flow components of a system are those elements that the system transforms or changes. Examples here consist of the soldiers and units that conduct training within the BCTC. As we will discuss later in the report, for our purposes these flow components consisted of the training events themselves.

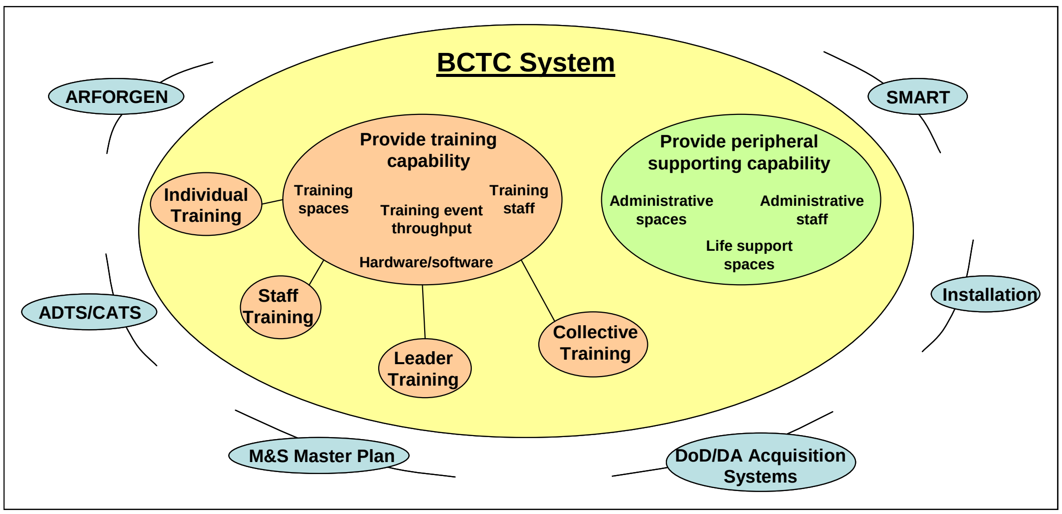

Figure 2.1. Systems context diagram reflecting the hierarchical structure and components of the BCTC system, as well as the super-systems of which it is a part.

The hierarchical structure within which a BCTC falls includes it super-systems (those systems of which the simulation is a part), lateral systems (others systems that are similar in objectives, goals, or structure to the BCTC), and its sub-systems. A BCTC that meets the Army's needs is primarily part of the following super-systems: the Department of the Army's (DA) SMART program, DoD/DA acquisition systems, DA's Modeling and Simulation (M&S) Master Plan, the ADTS and CATS, the ARFORGEN model, and the installation it supports. Lateral systems include battle simulation centers, close-combat tactical training

centers, mission-support training facilities, and other installation training facilities and mechanisms that are tied to or integrated with the BCTC. Critical subsystems include individual training systems, collective training systems, simulation/stimulation systems, and technical support systems. Figure 2.1 above shows a systems context diagram that captures the hierarchical structure and components of the system.

By conducting the above analysis, we identified key aspects of the system under study that must be considered throughout the process, which comprise the core training capabilities BCTCs are expected to possess to fulfill their roles. Additionally, by putting the entire system in context, we were able to identify other systems and factors in the environment that directly affect any proposed simulation solution.

2.2.3. Research and Literature Review

Subsequent to our initial meeting with our client, we began an extensive search of the existing literature and research related to our topic. Our system decomposition assisted in this endeavor by highlighting the critical sub-systems and components affecting our problem. The Bibliography section of this report contains a comprehensive list of these references, which we grouped into the topic areas that frame the following discussion.

2.2.3.1 Training Strategies and Documents

In order to broaden our understanding of the functional purposes and objectives of Battle Command Training Centers, we first reviewed Army training strategies and objectives the Army expects them to support. These documents and references essentially lay the foundation for force readiness expectations, which BCTCs must support.

The first of these is the Army's Digital Training Strategy, which is the Army's means for describing its four-phased process for maturing battle command concepts and training using the current repertoire of digital C4ISR systems in use around the Army, as well as projected systems currently under development. The four phases consist of: 1) skills establishment, in which soldiers and units develop the fundamental skill-sets necessary to employ the systems; 2) skills improvement, whereby users improve upon their ability to operate the system and system of systems in all environments; 3) skills sustainment, in which users train to sustain skills and operational capabilities in support of readiness and the full

spectrum of military operations; and 4) "delta training", which addresses the means and plan by which to accommodate planned or unplanned changes to digital systems in order to maintain a functional operating capability. This document proved one of the most fundamental and important references we used, as it articulates precisely what training objectives BCTCs must support and provides a detailed description of what roles the Army expects BCTCs to play. Moreover, the ADTS contains the Battle Command Training analytics and metrics used to define, in part, the training capability required of these facilities in terms of space, staff, and hardware.

We next turned to the Army's Combined Arms Training Strategy. Where the ADTS frames the Army's strategy for developing and sustaining a digital battle command training capability, the CATS establishes the framework for how these aspects get integrated into the broader aspects of traditional combined arms training. In particular, the U.S. Army Training Support Center describes CATS as "the Army's over-arching strategy for current and future training of the force (USATSC, 2006)." In short, it describes how the Army intends to train the force to standard, integrating the aspects of force transformation and digitized systems to facilitate battle command.

The third and final document we reviewed in this category was the Army Forces Generation Model. Conceived to address the new realities of continuous operations and persistent conflict, the ARFORGEN model essentially replaces the TPFDD methodology for preparing and deploying units in support of peace and wartime missions. Specifically, the Army Staff purports that the model establishes a "structured progression of increased unit readiness over time, resulting in recurring periods of availability of trained, ready, and cohesive units prepared for operational deployment in support of regional combatant commander requirements." Accordingly, this document, in conjunction with the first two, provided us with a refined and clearer picture of the operating environment for BCTCs in terms of training throughput.

2.2.3.2 Modeling and Simulation Policies and Guidelines

Given the increasing integration of simulations into the training environment, we familiarized ourselves with relevant Army and DoD policies, regulations, and guidelines that govern the various aspects of modeling and simulation. We found documents pertaining to

the Army's SMART program of particular use, as these helped to establish a context for developing alternatives and comparing them. The Planning Guidelines directly apply modeling and simulation principles to guide system development and describes their intended use throughout the acquisition process (AMSO, 2002). DA PAM 5-12, Simulation Support Planning and Plans (2005), describes the requirement for simulation support plans (SSP) for all major acquisition programs, focusing on the integration of these plans in the context of the SMART program. It further details the required information for SSPs, which are essentially "roadmaps" that specify how M&S will support a concept or a system's life cycle.

2.2.3.3 BCTC-Related Research and Documents

The documents in this category consisted of information relevant to the development and design of BCTCs or similar training facilities. The first of these was a paper describing the design and development of the Korea Battle Simulation Center (KBSC) (Hartley et al, 2005). Although a battle simulation center is somewhat different from a BCTC in terms of size and scope (the latter having a broader and more all-encompassing purpose with respect to individual and collective training), the concepts and considerations for designing and developing capability are scaled versions of each other.

The second reference dealt specifically with the newly constructed BCTC at Fort Wainwright, Alaska. Written as a case study from an architectural engineering perspective, this reference provided relevant insights into design requirements and criteria, as well as a broader understanding of the design process.

Our third source of information in this category consisted of the various workshop presentations obtained through our participation with the BCTC Working Group and Design Board. These presentations provided valuable overviews on BCTC purposes and concepts, the integration of live-virtual-constructive strategies into battle command training, and the overall charter and objectives of the BCTC Working Group and Design Board, which we will discuss in subsequent sections of this report.

2.2.3.4 Other Documents & Information

These documents provided additional information that we found relevant to our problem in the context that they described certain aspects of training and capability that were

pertinent to BCTC capability and design considerations. Of particular relevance were discussions, descriptions, and considerations of future training needs and technologies as they pertain to the evolution of battle command training capabilities.

2.2.4. Stakeholder Analysis

In conjunction with our search of relevant literature and concurrent research efforts relating to our project, we exerted efforts to capture and analyze the needs and opinions of the various critical stakeholders. In the context of this particular project, a stakeholder consisted of any organization or individual who had a vested interest in the outcome of the project. We grouped our stakeholders into four broad categories, which are reflected in the following figure.

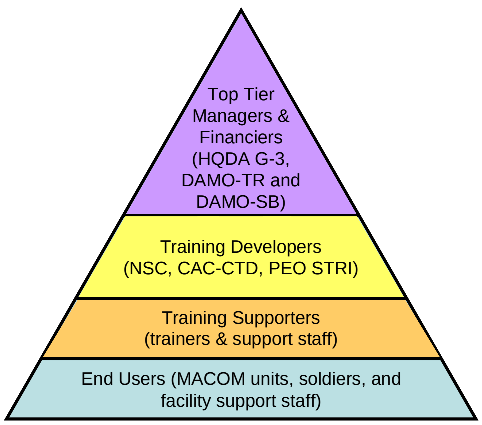

Figure 2.2. Stakeholder categorization.

2.2.4.1 HQ, Department of the Army (HQDA G-3 (DAMO-TRS))

Although the BCSE Directorate is the primary client who commissioned the ORCEN's participation on this project, we determined early on that ours was a piece of a much larger effort underway within the larger HQDA staff, specifically the G-3 section. As the "most prominent integrating device in the Army", the headquarters facilitates and ensures mission accomplishment in terms of the major organizational tasks. Within the G-3 section are several subsidiaries, including the BCSE Directorate (DAMO-SB) and the Training Simulations branch (DAMO-TRS). The DAMO-TRS provides "policy, procedures, and resource management for the training modernization, combat training center modernization, as well as range and training land management that support and enable the execution of the

Combined Arms Training Strategies (AMSO, 2003)." Some of the primary functions of the DAMO-TRS include:

- Plan, program, prioritize, and budget the live, virtual, and constructive non-system training aids, devices, simulations, and simulators (TADSS) and training infrastructure that directly support the execution of training at home-station, the Combat Training Centers (CTC), and during deployments.
- Maintain fielded training devices through contracted logistical support; support operations and maintenance for all fielded/non-fielded systems TADSS to meet home-station and CTC training requirements (AMSO, 2003).

There exists a clear correlation between these functions and the role of the BCTC in achieving the digital and combined arms training strategies. Accordingly, the DAMO-TRS has a vested interest in the shape and capabilities that these facilities will assume.

On 14 December 2005, we conducted an interview with LTC Darran Anderson of DAMO-TRS. LTC Anderson is currently serving as the project-lead for developing a standardized BCTC template that can be applied to the design and development of future facilities across the Army. The purpose of our interview was to ascertain the perspective of the DAMO-TRS with respect to what this design template should incorporate. He raised the following points for consideration:

- The facilities will be designed and built to accommodate Active Component units on particular installations.
- It is not necessary to factor in National Guard and Reserve units as, at any one time, AC units will be deployed, indicating that the training capability would not be taxed.
- Consider the ARFORGEN model, as it will affect the types, quantities, and frequencies of training events, as well as the timing of particular events and whether units will skip events based on variables in the cycles.
- Metrics have been developed and are in use, but they have not been validated per se using OR approaches or methodologies.

2.2.4.2 BCSE Directorate (DAMO-SB)

We held our initial project meeting on 1 September 2005 via Video Tele-Conferencing. During that meeting, we briefed COL George Stone, the Director of the

BCSE Directorate, on our project plan. Subsequent to our briefing, COL Stone provided additional guidance and clarification. We will only discuss the most pertinent information here. COL Stone and LTC Favio Lopez, the project lead within the BCSE Directorate, stated the following observations/points about the project

- BCTCs are going to become the center of all modular forces, particularly when the force becomes Future Combat System (FCS)-equipped in 2017.
- Layout and design are driven by the required capabilities and training throughput in terms of unit training needs, personnel (users and staff), network and communications infrastructure, and hardware needs.

Pursuant to these points, COL Stone indicated that the key question of interest concerns how the Army should best design these centers to facilitate digitization and transformation goals with respect to training strategies and battle command. He further stated that the project was not a study, but rather a project aimed at providing hard recommendations for a design solution.

On 15 September 2005, we presented our first Interim Progress Report to COL Stone at the BCSE Directorate in Crystal City, VA. During this meeting, we reported the results of our literature review and stakeholder analysis to that point. COL Stone and LTC Lopez provided additional clarification as to the direction and purpose of the project. When asked about the specific questions they required answers for, they cited the following:

- What do these facilities need to look like and what are they supposed to do?
    - How do we man them?
    - How do we equip them?
    - How do we address the need for reconfigure-ability?
    - What are the core capabilities that they must possess?
- Can existing facilities actually do what they are supposed to do?
- What time-frame should we be considering for facility design and development?

These questions underscored the premise that any layout design be capabilities-driven in terms of the training throughput and that it be forward-thinking so as to accommodate the anticipated needs of the future force. According to COL Stone's staff, to date, little rigor has been applied to verify the needs or the capabilities to address training throughput

requirements with respect to unit training needs/requirements and space, staffing, and network/hardware requirements. In short, COL Stone articulated a need for a capabilities-based design template that assures the requisite training capability to achieve Army training and readiness objectives and that this template be built upon a solid analytical foundation and rooted in the common principles of Operations Research.

2.2.4.3 BCTC Working Group and Design Board

The BCTC Working Group and Design Board comprises the lower three categories reflected in Figure 2.2 above. Forming by the group in the fall of 2005, HQDA G-3 (DAMO-TRS) commissioned it to develop a standardized design template for the Army's future battle command training centers. The group consists of representatives from the organizations shown in Figure 2.3 below. As the figure suggests, our project team was brought into the working group by the BCSE Directorate. Our specific charter therein: bring an OR methodology to bear to ensure that the resulting training capability and design were the result of and supported by a solid analytical approach.

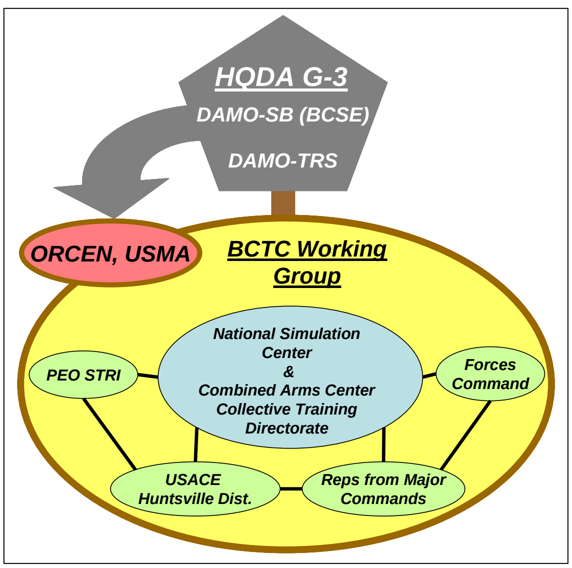

Figure 2.3: Composition of the BCTC Working Group and Design Board

Pursuant to achieving its charter, the working group delineated objectives that would enable it to arrive at a standardized template solution. The group's objectives were to:

- Develop metrics for sizing, staffing, and equipping the BCTC;
- Develop metrics for ascertaining average daily occupancy levels;

- Develop functional requirements for the facility; and
- Develop a standardized design templates that reflect the physical footprint of the facilities, the composition of the capabilities therein, and the staffing required to operate them.

Within the context of those objectives, the BCSE Directorate integrated our project team into the working group specifically to provide an "OR-based approach in order to add mathematical rigor to the process." Our role would include

- Validating the metrics for sizing, staffing, and equipping the BCTC;
- Evaluating the training capability of the preliminary designs developed by the working group; and
- Use results of modeling and analysis to provide recommended modifications to the designs to ensure that they achieve the requisite training capability.

2.2.5. Functional Analysis

2.2.5.1 Development of Functional Requirements

The development of the preliminary design first required an examination of the core training functions that BCTCs must perform. According to the ADTS, The facility will have multipurpose classrooms (MPCRs) to support training on various digital Army battle command systems (ABCS), a reconfigurable TOC (RTOC) area that can replicate battalion through Corps command posts or elements, and AAR capabilities. It will provide a low overhead driver for ABCS stimulation, as well as access to the digital training resources. The RTOC areas, with the use of simulations and observer/controllers, must afford digital staffs (battalion through Corps) the opportunity to conduct low-overhead simulation training in a multi-echelon training environment (CAC-CTD, 2004).

These functions comprise the various aspects of individual and collective training. The amount of space, staff, and other resources to allocate to these functions stemmed from the various resourcing and occupancy metrics previously mentioned. In addition to those core training functions are the "peripheral" supporting functions that encompass administrative spaces, life support (latrines, showers, etc.), and training support spaces, all of which also

stem from those metrics. Appendix C contains the functional requirements matrices developed by the Working Group.

2.2.5.2 Functional Hierarchy

To further define the BCTC requirements developed by the BCTC Working Group, we applied a common methodology involving a decomposition of the required BCTC functions and arranging them into a functional hierarchy. At the highest level, we began with requirement that these facilities provide a requisite level of battle command training capability, which equates to a "fully integrated and mutually supportive capability which most effectively supports the full range of commanders' training requirements for all appropriate echelons (CAC-CTD, 2004, 28)."

.This decomposed into two primary sub-functions: 1) provide adequate training capability to achieve annual training throughput requirements and 2) provide requisite peripheral (administrative) capability to support the first. From there, we continued to decompose into lower-level sub-functions until we achieved a level below which the training capability would be unaffected. Figure 2.4 shows the upper levels of our decomposition of BCTC functions. See Appendix D for the complete functional hierarchy.

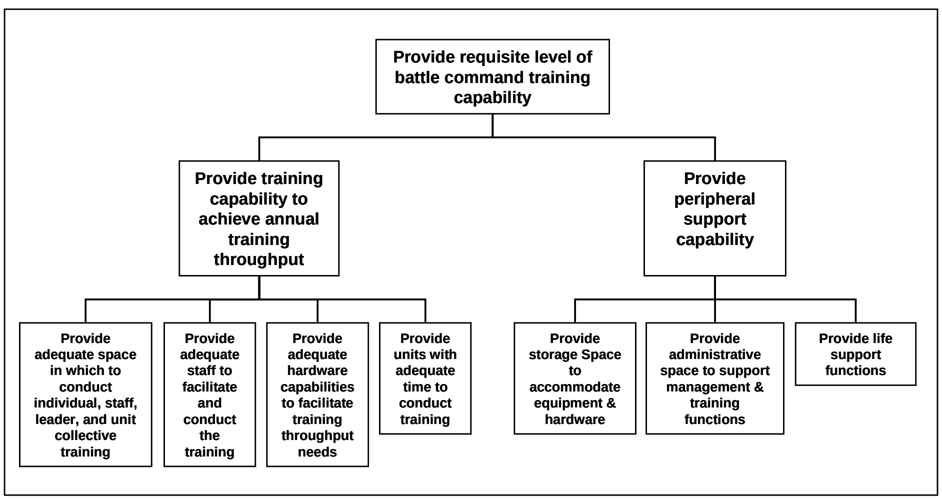

Figure 2.4. Functional decomposition of primary BCTC functions into critical sub-functions.

Once the Working Group decomposed the critical functions for the BCTC system, we began development of a functional requirements matrix that would encapsulate the core training functions and combine them with the peripheral supporting functions to establish a

complete set of facility functions for the design template. However before we could do this, we had to address the disparities between the needs of different installations.

Ultimately, the battle command training capability required at any particular installation would be driven by the number, types, and sizes of units the BCTC would support. For some installations, this amounts to several brigades, a division headquarters, and a corps headquarters (i.e., Fort Bragg or Fort Hood). For others, this could amount to a single brigade and subordinate units (e.g., Fort Wainwright). Accordingly, the Working Group delineated specifications for large, medium, and small BCTCs that would correspond to installations and the unit densities therein. The following table summarizes the specifications for each BCTC size.

Table 2. BCTC size correlations to installation unit densities.

Size	Installation Correlation	Examples
Large	Installations with corps-level (or three-start equivalent) headquarters and below	Fort Hood, Fort Bragg, Fort Lewis, etc.
Medium	Installations with division-level (or two-star equivalent) headquarters and below	Fort Drum, Fort Campbell, Fort Stewart, etc.
Small	Installations with one or two brigade-level headquarters and below	Fort Wainwright, Fort Polk, Fort Knox, etc.

2.2.6. Revised Problem Statement

Based upon the results of our needs analysis, we developed the following revised problem statement that more clearly articulates the effective need:

Identify a Battle Command Training Center design that facilitates the annual training throughput required by installations and directed by the Army's Digital Training Strategy (ADTS) and the Combined Arms Training Strategy (CATS). This facility should possess a baseline capability that: 1) fulfills current and evolving training requirements with respect to Live-Virtual-Constructive (L-V-C) capabilities and environments; 2) facilitates timely reconfiguration in preparation for future training events; 3) facilitates intra-installation, inter-installation and inter-service operability; and 4) is robust enough to accommodate the anticipated needs of the future force to include range instrumentation and embedded training. The design and layout of the facility must be such that it can accommodate both the sequential and simultaneous execution of training events ranging from individual to Corps level, as well as adapt to the eventuality of simultaneous execution of the L-V-C components within supported training events.

2.3 Value System Design

2.3.1. Functions and Objectives

We next turned to value-focused thinking to provide a system with which we could evaluate the alternative solutions we would develop later. Beginning with our functional hierarchy (Figure 2.4), we kept those lowest-level functions that would allow us to differentiate between candidate alternatives in terms of the impacts on training capability. For each of these we determined objectives, based upon the needs and desires of the stakeholders. We should note here that, in the context of this problem, costs were not an issue. Simply put, our task was to determine the minimum essential capabilities that a BCTC must possess in order to achieve annual throughput expectations. Pursuant to that, costs would be factored in by the BCTC Working Group later in the overall design process. As such, in our process, we do not account for it in the value hierarchy. We will, however, discuss costs when we discuss our results and recommendation. The functions and objectives can be seen in the completed value hierarchy shown in Figure 2.5. Note that this only

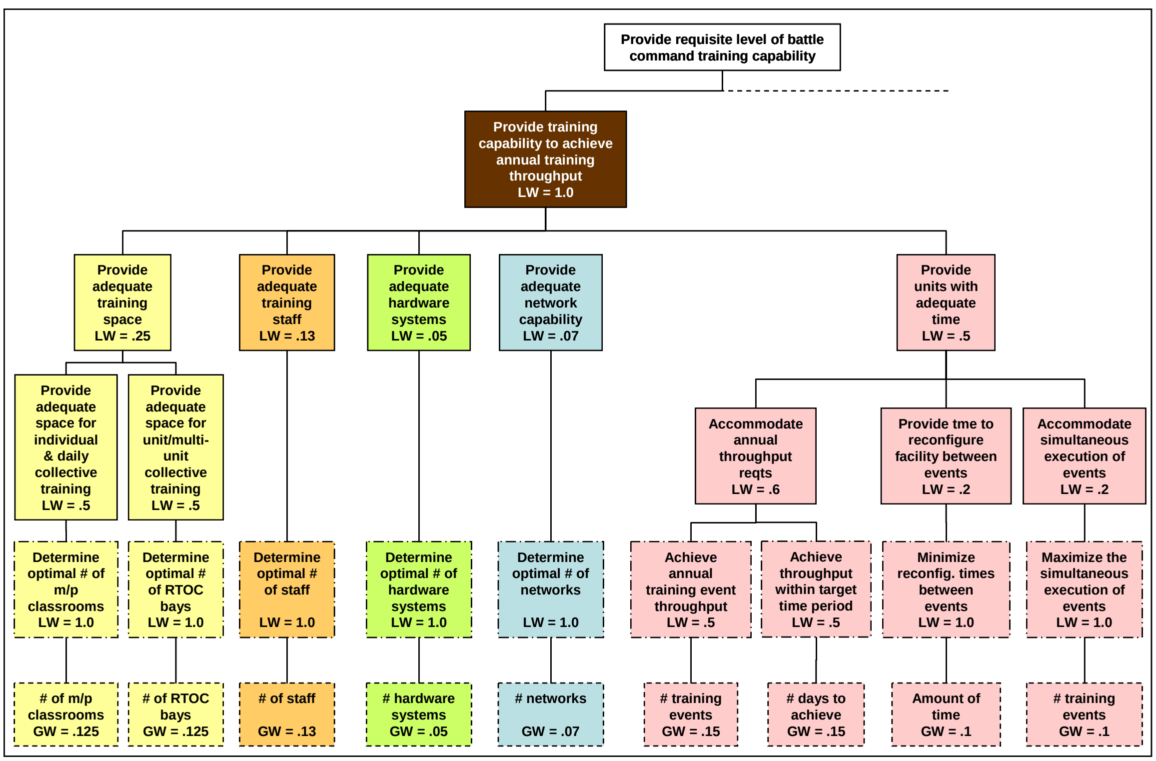

Figure 2.5. Value hierarchy for the "Provide Training Capability" function.

reflects the left side of the functional hierarchy, both for reasons of space and design. As we will discuss in the Weighting paragraph of this section, this is because the functions associated with the peripheral capability were deemed unnecessary in the scoped context of our role in this problem. Nevertheless, we did include these branches in the complete value hierarchy found in Appendix D.

2.3.2. Evaluation Measures

Below each objective, we selected an evaluation measure that we would use to measure the degree of attainment of that objective. As the following table shows, each measure consists of a name, its units, evaluation goal, and a description.

Table 3. Description of evaluation measures used in the Value Design process.

Measure	Units	Goal	Description
Multipurpose Classrooms	# classrooms	Minimize	The classroom space required to support individual and daily lower-level collective training
RTOC Bays	# RTOC bays	Minimize	The space required to accommodate unit command posts (CPs) for upper level collective training (one bay supports a battalion-sized CP; 2 support a brigade CP; division and corps CPs would require all bays)
Staff	# staff (by type)	Minimize	The training and administrative staff. For training staff, this breaks down into five distinct types, which will be discussed later in the report
Hardware	# systems	Minimize	The number of white-box systems required to conduct training events
Networks	# networks	Minimize	The number of networks required to conduct collective training events (for example, if two brigades want to conduct their own CP exercises, each would require a distinct network to run their simulated scenario.
Training Throughput	# training events	Target Value	The annual training event throughput. This is a constraint on the system, as any alternative must achieve specified throughput levels.
Time to Achieve Throughput	# days	Target Range	The number of days required to achieve training event throughput. Rather than minimize, we elected to target a range between 220 and 235 days, which we will discuss later in the report.
Reconfig Time	Amount of time	Minimize	The amount of time required to prepare or reconfigure spaces between training events
Simultaneity	# training events	Maximize	The number of events that can occur simultaneously. In general, we want to maximize this to most efficiently use space and time.
Storage space (Unclassified)	Square feet	Minimize	The amount of space required to store unclassified materials, particularly hardware systems
Storage space (Classified)	Square feet	Minimize	The amount of space required to store classified materials, particularly hardware systems; requires different specifications than above
Staff space	Square feet	Minimize	The amount of office/work space required to accommodate staff levels
Training Support space	Square feet	Minimize	The amount of space multipurpose conference space required to support other aspects of training,
Entry Control Point space	Square feet	Minimize	The need to control flow within the facility, particularly when classified and unclassified events are occurring simultaneously.
Latrine space	# latrines	Minimize	The numbers of male and female latrines necessary to support expected daily throughput
Break Room space	# break rooms	Minimize	The numbers of break rooms necessary to support expected daily throughput
Flow spaces	Square feet	Minimize	The amount of space necessary to support expected daily throughput.

2.3.3. Weighting.

With the hierarchy complete, we assigned local weights (LW) to the functions and objectives that reflected our client's needs and desires. For this discussion, it is helpful to refer back to Figure 2.5, the value hierarchy for the training capability. Local weights indicate the value of that function or objective versus others on the same branch and level in the hierarchy, and must sum to 1.0 within each branch and level. For example, the highest level functions are *provide training capability* and *provide peripheral capability*, to which we assigned local weights of 1.0 and 0.0 respectively. We based this on the stakeholders' desires that we focus strictly on training capability for the purposes of our role in the project. On the next level, under *provide training capability*, we assigned local weights according to their relative level of importance to the client. As these numbers indicate, the time to conduct training, the provision for space, and the provision for staff are most important to the stakeholders and are fairly close in relative importance, whereas hardware systems and networks are less important. This seems logical, as the numbers of hardware systems and networks can be considered a by-product of the staff size and numbers of throughput events. It is normally not as accurate to assign weights from top-down. However, due to the simplicity of our hierarchy (few levels and branches), we determined that working top-down would still provide accurate weights. Our resulting global weights confirmed that.

We derived the global weights (GW) for each of the evaluation measures by multiplying the LW of each objective and function along the branch of the hierarchy from the topmost function to the lowest sub-function. The global weights indicate the relative stakeholder value of each of the evaluation measures with respect to all of the others and sum to 1.0. Table 4 on the following page contains a list of the evaluation measures listed by relative importance to the client.

Table 4. Evaluation measures sorted by global weight.

Evaluation Measure	Global Weight
Training Throughput	0.15
Time to Achieve Throughput	0.15
Staff	0.13
Multipurpose Classrooms	0.125
RTOC Bays	0.125
Simultaneity between events	0.10
Reconfig Time	0.10
Networks	0.07
Hardware Systems	0.05

Chapter 3: Design and Analysis

3.1 Overview

After developing and refining our understanding of the problem in the Problem Definition phase, we transition to the Design and Analysis phase of the SEMP to develop alternative solutions to the problem. More importantly, we will ultimately model the problem in order to analyze the performance of the system relative to value hierarchy.

The results of the functional analysis and development of functional requirements discussed in Chapter 2 raised an intrinsic question on which we focused our modeling and analysis efforts for this project. In short, do the requirements identified by the working group provide adequate training capability to achieve the Army's near/long term training strategies and objectives? In this chapter, we will discuss how we organized and executed our modeling approach to answer this very question.

3.2 The Base-Case Design

The Base-Case or preliminary design evolved from the functional requirements and the space and staff metrics developed by the BCTC Working Group. In the context of training capability, this design describes the amount of space and staff required to achieve throughput objectives. As the term base-case implies, we viewed this capability as an untested starting point simply because although it had been developed using requirements and metrics that are based on the ADTS, CATS, and ARFORGEN, it had yet to be verified against total anticipated annual throughput. Table 5 depicts the base-case training capability in terms of the numbers of multipurpose classrooms, RTOC bays, and total staff.

Table 5: The training capability of the base-case design.

	Multipurpose Classrooms	RTOC Bays (total interior & exterior)	Total Staff
Large BCTC	7	15	130
Medium BCTC	4	10	87
Small BCTC	3	5	33

3.3 Approach

Our approach consisted of stripping away the peripheral functions and focusing on the training capability. For our purposes, we defined training capability as a product of the space dedicated to individual and collective training and the staff needed to facilitate that training. Focusing on this core capability as the nucleus of any effectual design, we could then develop a simulation model to represent the BCTC system. Since the training throughput represents the annual requirement that the capability must address, our approach centered on it as the input source for the model. We could then structure the model so as to determine the "optimal" mix of space and staff to fulfill the core training capability requirements.

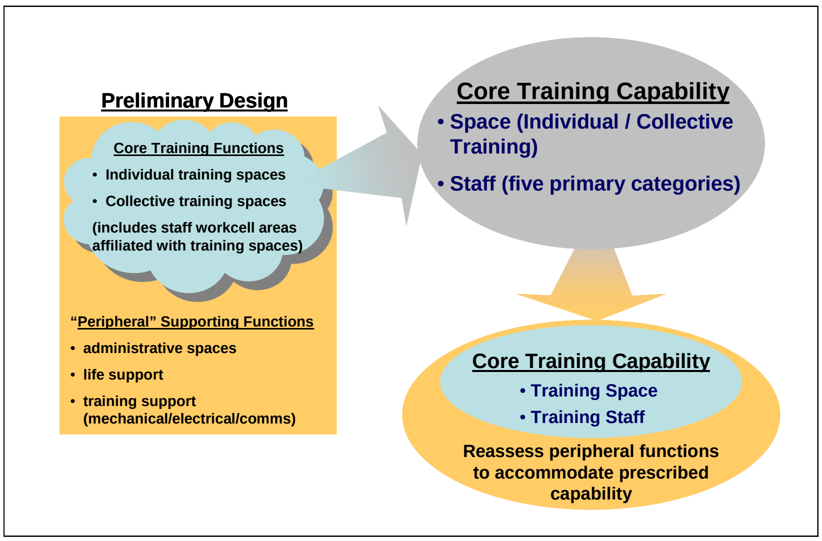

Figure 3.1: Visualization of our general approach to modeling the problem, depicting our efforts to strip away the peripheral functions and focus strictly on the training capability to assess the adequacy of the .

As the figure clearly shows, determining the core training capability would essentially establish the training nucleus of the facility in terms of a physical footprint and staff requirements. Subsequent to this, we could then reassess or modify the "peripheral" requirements in order to accommodate the capability prescribed by our model for each of the three BCTC sizes. Pursuant to discussions within the BCTC Working Group, we could then move forward with a final, capabilities-based design recommendation.

3.4 Simulating the Training Capability

3.4.1. Simulation Purpose and Modeling Approach

"Rather than leave design decisions to chance, simulation provides a way to validate whether or not the best decisions are being made (Harrell et al., 2004, 6)." The over-arching purpose of our simulation was to do just that: provide a means to simulate the training capability established by the base-case design in order to validate whether that capability was adequate to achieve expected training throughput requirements. In the event that we found it inadequate, we could then evaluate modifications to the capability to accommodate throughput requirements.

3.4.2. Modeling Approach

To facilitate our modeling objectives, we approached the modeling phase using Law and Kelton's framework for conducting a simulation study. Reflected in the following figure, this framework consists of a ten-step process to facilitate a comprehensive approach to developing, constructing, and implementing a simulation model (Law and Kelton, 2000).

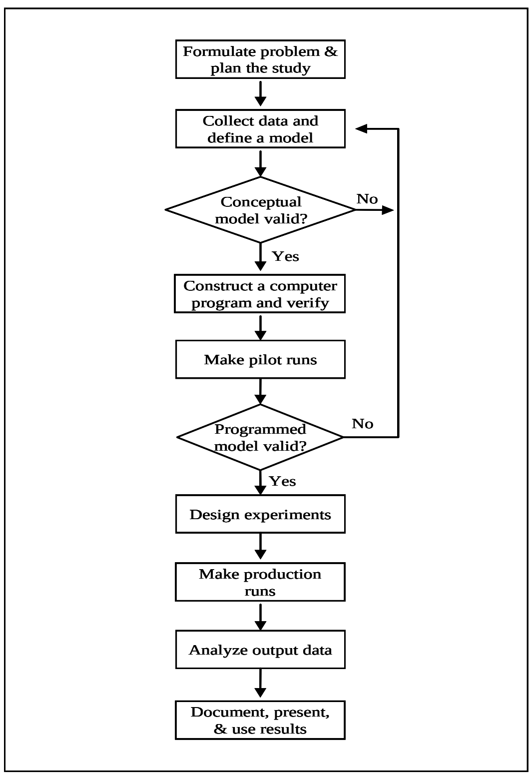

Figure 3.2. Steps in a simulation study (Law and Kelton, 2000, 84)

3.4.3. Problem Formulation and Study Plan

Within the context of our simulation approach, we elected to formulate our simulation problem from a queuing theory perspective. We have a set of customers (units) that require various types of service (different training events), a multi-faceted service facility, and a limited amount of time in which to accommodate all customers. Accordingly, we mapped out our approach using the basic components of a queuing system, specifically the input source, the queuing mechanism, and the service mechanism, all of which translated to the following:

- **Input source:** entities based on training event types, relative frequencies, and durations
- **Queuing and service mechanisms:** capability measured in terms of space, staff, and time
- **Mechanisms for influencing system performance:** consideration of alternative technologies and their impacts on capability (i.e., wireless vs. hard-wired)

Following this approach, we used these three components to develop the skeletal structure of the model. This essentially provided us with a solid, theory-based framework with which to construct the simulation as an accurate representation of the BCTC system. We should note here that, in the context of this particular project, the above components are listed in order of significance. The entities in this model represent the annual training requirements dictated by the ADTS, CATS, and ARFORGEN model. These are actually fixed numbers and act as constraints on the system. Thus, any facility design must be capable of achieving these requirements. The capability, then, is the true variable in this approach, as we aim to massage it and refine it in order to accommodate the input source. Finally, the consideration of alternative technologies represents “outside the box” perspectives on how we might refine the capability.

3.4.4. Data Collection

Our data collection effort focused on establishing our entity base for the simulation model. In order for the model to function properly and accurately, we needed to ensure our entity pool accurately reflected the training events it represented. Accordingly, our collection efforts followed the process reflected in the diagram on the following page.

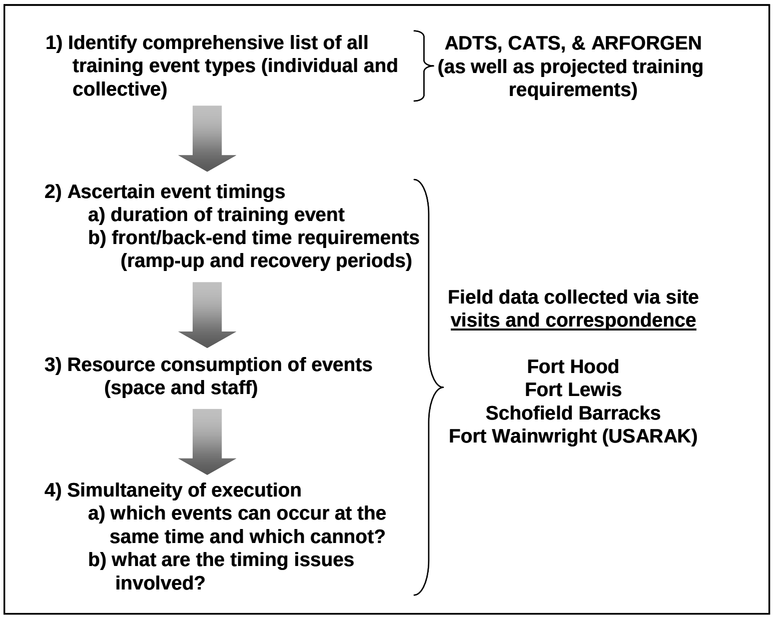

Figure 3.3. Data collection process.

As the diagram shows, we obtained training event data from two sources: the various training strategies and documents and the BCTCs listed. While the training strategies and ARFORGEN documents enabled us to develop a comprehensive list of annual individual and collective training event requirements, they did not provide much relational information about the events in terms of time and resource requirements or simultaneity of execution. Since the flow and processing logic of any simulation model would rely on these types of information in particular, we sought to collect field data from several BCTCs, which enabled us to fill in the gaps alluded to in the diagram above.

3.4.5. Defining the Model

In the midst of our data collection efforts, we began our initial model development by building the framework. This essentially was a three-phased approach wherein we identified specific throughput pools for each BCTC size, developed critical modeling assumptions to aid in the modeling process, and then constructed flow diagrams to assist in the development of model logic.

3.4.5.1 Model Throughput

As previously mentioned, we based our model throughput on the number, sizes, and types of units using the BCTC, as well as their respective densities of digital systems in their Modified Table of Organization and Equipment (MTOE). While the types of units spanned from the individual soldier through Corps and Joint-level exercises, the number and sizes of each type depended on the unit composition at installations. To address the differences, we used the large-medium-small concept adopted by the BCTC Working Group to determine how many of each unit type would require the use of the BCTC at each installation type, which we previously addressed and is reflected in Table 2. For simplicity, recall that a large BCTC supports an installation with a Corps-level headquarters, a medium BCTC supports in installation with a division-level headquarters, and a small BCTC supports an installation with a brigade combat team headquarters.

Once we identified the unit compositions, we then turned to the ADTS, CATS, and ARFORGEN model to develop the complete pool of individual and collective training events. For the individual training events, we used the metrics provided in Appendix C of the ADTS, which were developed by the BCTC Working Group for the DAMO-TRS. These metrics essentially use the MTOE authorizations to ascertain the annual soldier load for each type of individual training. We then used these figures to determine the number of times each training event would have to occur annually in order to achieve throughput requirements. Table 6 on the following page reflects the annual individual training load by training event type. These training events represent all ABCS systems that units currently have and operate or systems that are scheduled for fielding and have programs of instruction associated with them (e.g., JADOCS). We should note that we did not include anticipated training events for systems under development and planned for future integration, as these systems currently have no programs of instruction associated with them that convey any notion of frequency, duration, and resource consumption. However, it is equally important to note that, as this report will show, these events can be easily integrated into our model as they evolve.

Table 6. Annual individual training event load, in numbers of events per year, as determined using ADTS (Appendix C) metrics.

	Large BCTC	Medium BCTC	Small BCTC		Large BCTC	Medium BCTC	Small BCTC
AFATDS – O	6	5	2	**FBCB2 – I**	32	37	10
AFATDS – I	3	3	1	**FBCB2 – L**	9	11	4
AFATDS – L	2	1	1	**FBCB2 – S**	113	134	37
AFATDS – S	10	9	2	**FBCB2 ULM – O**	3	3	1
AMPDCS – O	1	1	1	**BFT – O**	48	0	0
AMPDCS – I	1	1	1	**BFT ULM – O**	2	0	0
AMPDCS – L	1	1	1	**DTSS –O**	1	1	1
AMPDCS – S	1	1	1	**DTSS – I**	1	1	1
ASAS-L – O	4	4	2	**DTSS – L**	1	1	1
ASAS-L – I	3	3	1	**DTSS – S**	2	2	1
ASAS-L – L	1	1	1	**TAIS – O**	1	1	1
ASAS-L – S	8	8	2	**TAIS – S**	1	1	1
BCS3 – O	5	2	0	**GCSS-A – O**	2	2	1
BCS3 – L	1	1	0	**GCSS-A – S**	3	3	1
BCS3 – S	10	4	0	**C2PC – O**	1	1	1
MCS-L – O	12	12	2	**C2PC – L**	1	1	1
MCS-L – I	7	7	2	**C2PC – S**	1	1	1
MCS-L – L	2	2	1	**CPOF – O**	6	6	2
MCS-L – S	24	23	4	**CPOF – L**	2	2	1
FBCB2 – O	57	67	19	**JADOCS - O**	1	1	1

Legend:

O – Operator training **I** – Integrator training **L** – Leader training **S** – Sustainment training

As an example, consider FBCB2 operator training at a large BCTC. Based on the metrics, the facility must accommodate 1,686 soldiers annually. Using a planning factor of 20 soldiers per class, we can determine that the total number of FBCB2 Operator's courses per year is then 1,686/20 = 85. Appendix E contains the full compilation of the individual training event matrices that we used to ascertain the annual training event load.

The collective training events stem from the training matrices that accompany the ARFORGEN model. In short, these matrices delineate the annual training requirements for specific training events by unit echelon. As such, we could then determine the annual collective training event load simply by multiplying the number of each event type required in a year by the number of each respective unit size. Consider platoon-level situational training exercises (PLT STX) as an example. According to the ARFORGEN model, each platoon is required to conduct two these in a digital or constructive environment each year. For a large BCTC, we determined that a unit composition of three heavy brigade combat

teams (HBCT) would equate to approximately 108 platoons. This obviously translates to 216 PLT STX events per year that the facility must be capable of accommodating. Table 7 reflects the annual collective training event load by event, as derived from the ARFORGEN model (DA, 2005a); Appendix F contains the complete set of collective training matrices.

Table 7. Annual collective training event load, in numbers of events per year, by training event type and BCTC size, as determined using ARFORGEN model training matrices.

	Large BCTC	Medium BCTC	Small BCTC
Platoon STX	144	144	48
Company STX	48	48	16
Battalion staff training (classroom-focused event)	33	24	8
Brigade staff training (classroom-focused event)	23	14	4
Battalion CPX	14	10	3
Brigade CPX	9	6	2
Division CPX	1	2	0
Division WFX	1	1	0
Corps CPX	1	0	0
Corps WFX	1	0	0
Joint Theater Exercise (JTX)	1	1	0
Legend: STX – Situational training exercise CPX – Command post exercise WFX – Warfighter exercise			

Although we will address our modeling assumptions in the next section, we should note here that the numbers in the above two tables reflect our critical assumption that, given the Army's current continuous-state of deployed operations and the understanding of modular brigade deployment cycles articulated in the ARFORGEN model, 1/3 of the using units on any installation would be deployed in any given year. As such, the above numbers reflect a 1/3 adjustment downward to account for this.

Thus, the training event throughput for our model is comprised of the total annual individual and collective training event load. These numbers, reflected in the following table, represent hard constraints that BCTC capabilities must achieve.

Table 8. Total annual training event throughput by BCTC size.

Total Training Throughput (#of training events per year)		
Large BCTC	**Medium BCTC**	**Small BCTC**
666	615	192

3.4.5.2 Critical Modeling Assumptions

For the purposes of developing the model, we formed several critical assumptions. Necessitated either by a lack of hard existing data or by the relative newness of Army strategies and the ARFORGEN model, these assumptions enabled us to bridge gaps in order to create a functioning model that would accurately and effectively portray the training capability of the BCTC. We grouped our assumptions into five relatively broad categories consisting of entity throughput, time, space usage, resources, and simultaneity considerations. Appendix G contains the complete modeling assumptions document that we developed over the course of our model development, with descriptions as necessary.

3.4.5.3 Flow Diagrams

Before beginning the construction phase of a simulation, it is imperative to understand the true context of the system or systems under study in order to most accurately simulate them. According to Hillier and Lieberman, "a simulation model is often formulated in terms of a flow diagram that links together the various components of the system. Operating rules are given for each component, including the probability distributions that control when events will occur there. The [flow diagram] only needs enough detail to capture the essence of the system (Hillier and Lieberman, 2004, 955-956)."

In so doing, we developed a series of flow diagrams to facilitate a visualization of the BCTC system. We structured this visualization to reflect the various decision points within the model and thereby more accurately and precisely capture the flow of entities through the system. Equally important is that these diagrams enabled us to address the critical question concerning model validity posed by Law and Kelton's simulation study framework. The following figure shows the general flow diagram that reflects our model; Appendix H contains the full-sized diagram, along with two others that expand certain aspects to reveal logic development.

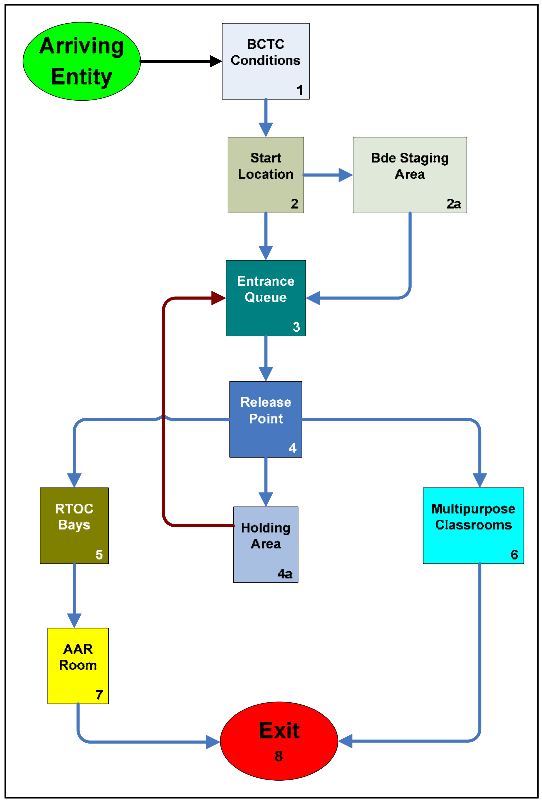

Figure 3.4. General flow diagram used for model development.

These diagrams essentially allowed us to execute a structured walk-through of the conceptual model using our assumptions. This, in turn, helped us to validate and/or refine our assumptions and then facilitated our development of the model code and the logic sequences that were necessary to accurately process entities through the system while capturing necessary data. They would also prove useful in the verification of our completed model, as we will discuss later in the report.

3.4.6. Constructing the Simulation

For the purposes of constructing our simulation model, we elected to use the ProModel simulation software package. Our primary reason for selecting this particular package in lieu of others is simply that we teach and use this software package in the Department of Systems Engineering and as a result, we have several site licenses already on hand. While we could have opted to create our simulation model using a common programming language that might require a lower *purchase* cost compared to simulation software, the fact that we already have site licenses available for ProModel renders this

irrelevant. Additionally, the use of a simulation software package “reduces programming time and results in a lower *project* cost (Law and Kelton, 2000, 86).”

3.4.6.1 Developing the Model Framework

The development of our model framework involved identifying and defining the various model components and parameters. Following the structure suggested in the ProModel User’s Guide, this essentially consisted of classifying the locations in the model, and then defining the entities, to include attributes, to be processed at these locations prior to actually developing the processing logic (ProModel User’s Guide, 2005).

Our flow diagrams provided the basis for identifying the locations within the model. These fell into two categories: 1) receiving locations and 2) processing locations. The first of these essentially served as a means to set the conditions in the model. They acted as a “buffer area” to sort out arriving entity types, assign attributes, and assess how to process them through the system. The second category consisted of those locations at which the entities actually get processed through the system and where data collection occurs. Table 9 on the following page lists the model locations by category and provides a brief description of each.

Pursuant to establishing our set of locations within the model, we defined the entities using the model throughput we described in section 3.5.5.1 for individual and collective training events. Again, these constitute the annual training throughput requirements that the facilities must accommodate. To define the entities, we determined the quantity (how many times a particular training event would occur in a year), duration (how long the event lasts, in days), and the frequency (how often they occur) for each. This allowed us to establish the entity flow into the system. Moreover, in order to adequately and accurately imitate the unique characteristics of the entities, we developed a list of attributes. These essentially serve as “numeric tags” that the model assigns to each entity, which enhances our ability to process and track them through the simulation (ProModel User’s Guide, 2005, 52).

Table 9. This table lists the various entity reception and processing locations included in the model. The descriptions explain their function therein.

	Location	Description
Receiving	Start Location	Location whereby the model builds each entity type by assigning attributes for reference numbers, type, training duration, and entry priority. The model also increments global variables that indicate the number entities of a particular type that have started, as well as the total number of entities that have started.
	Bde Staging Area	The model determines whether a Brigade CPX is there to train alone or with children battalions. If the latter, the entity is routed to this location to await the arrival of a statistically determined number of Battalion CPXs. If, for scheduling reasons, there are insufficient Battalion CPX entities remaining in the throughput pool, the model will adjust the number required to the number remaining.
	Entrance Queue	Acts as a bridge to control flow into the release point.
Processing	Release Point	Here occurs the most complex of the model processing sequences. This location serves as a launching point from which entities enter the BCTC system proper. When they arrive, the model finishes building each entity by adding the final attributes that fully define it. Based on the entities attributes and the existing conditions in the system, the model then looks to see if entities can enter. If yes, they proceed forward; if no, then they begin a holding pattern that continues until the conditions are such that they are able to enter.
	Holding Area	This location helps to thin out the Release Point as entities arrive. Specifically, it allows us to remove from the queue altogether those entities that cannot enter the system. This is important, as the system would other wise keep them at the head of the queue until the necessary conditions occurred. While we could have affected this, in part, by adjusting the queuing priority and selection rules within the model, this would have been far more complicated than simply adding a location that pulled entities out and pushing them to the back of the line.
	MPCR	The MPCR (multipurpose classrooms) is where all individual and daily collective training occurs. Entities are processed here pursuant to their attributes concerning the type, duration, and resource consumption of the event. Likewise, the model increments and decrements the appropriate global variables to account for the movement of the entity through the system.
	RTOC Bays	Location where all multi-day collective training occurs (CPXs, WFXs, and JTXs). Entities are processed here in the same manner as the MPCR. Here, the model also accounts for the probabilistic aspects associated with prepping for (ramping up) and reconfiguring (recovering) from these types of events.
	AAR Room	Used as a "way station" of sorts whereby entities departing the RTOC Bays pass for a specified period of time, to conduct post-training after action reviews (AARs). The location serves to capture the fact that certain event types continue to occupy portions of the physical facility footprint and staff resources even after the training has completed.
	Exit	The final processing location of the model, at which the model increments and decrements appropriate variables based on the type and attributes of the arriving entity in order to account for the impacts on throughput. Once this has occurred, the model will push the entity out of the system.

By the end of our framework development, we had 54 entities with 22 attributes each, as the following table summarizes. Appendix I contains the full model framework, including entity details and attribute descriptions.

Table 10. Summary of entities and entity attributes used in the simulation model.

Entities	Refer to Table 6 and Table 7 for a list of entities, which corresponds to the leftmost column in each.		
Attributes	Creation number Reference number Type Priority Training type Training duration RTOC Bays required Start Training	Training Ramp-up Days Training Execution Days Training Recovery Days Number of Training Days Training Days Remaining Training Level Training Phase	Number of Bns with Bde IT Staff required CT Staff required Sim/Stim Staff required TechSpt Staff required TngSpt Staff required Number of networks required

3.4.6.2 Use of Arrays

While we defined most of the attributes for each entity upon its arrival to the system (at the Start Location), in some cases we elected to use arrays to define the attributes as the entity flowed through various stages of the receiving locations. Since we are dealing with three different BCTC sizes, the number and types of entities and resources varies between them, which complicates the modeling process and would require that we create three times the number of entities to represent a large number of components. Moreover, such a course of action would result in three distinct models, one for each BCTC size, which we wanted to avoid for the purposes of maintaining the integrity of our approach between them. There are similar complicating factors involving the variations in resource consumption between entity types both in terms of how much of a particular resource they consume and for how long. The use of arrays simplifies the model by requiring the use of fewer entities and less processing logic, thereby enabling us to more efficiently assign and track attributes within the model.

To capitalize on the functionality that arrays provide, we developed and incorporated a total of eight arrays into the simulation model. Table 11 lists and describes these arrays in the context of how we used them in the model; Appendix J contains the arrays themselves.

Table 11. Listing and descriptions of arrays used to simplify the simulation model.

<table>
<tr><th>Array</th><th>Description of Use</th></tr>
<tr><td>Arr_tng_thrughput</td><td>Allowed the setting of the total throughput target based on BCTC size</td></tr>
<tr><td>Arr_staff_reqts</td><td>Established the staff levels available for use based on BCTC size</td></tr>
<tr><td>Arr_staff</td><td>Delineated staff consumption requirements based on collective training event type</td></tr>
<tr><td>Arr_DI_events</td><td rowspan="2">Allowed us to adjust the number of entity arrivals both for individual and collective training based on BCTC size</td></tr>
<tr><td>Arr_coll_events</td></tr>
<tr><td>Arr_tng_duration</td><td>Allowed us to partition the large-scale collective events (CPXs and WFXs) into their ramp-up, execution, and recovery periods</td></tr>
<tr><td>Arr_DI_tng_duration</td><td>While we collected individual training data in terms of 8-hour days, we constructed the model to operate on 24-hour days. Accordingly, we used this array to translate a set number of 8-hour days to 24-hour days.</td></tr>
<tr><td>Arr_networks</td><td>Allowed us to adjust network requirements based on the echelon being trained.</td></tr>
</table>

3.4.6.3 Use of Macros & Global Variables

Just as we needed arrays to simplify the complex dichotomy created by multiple BCTC sizes and the varying aspects of training events, we needed a way to have the model evaluate system performance based on modifications to the training capability, as well as a means to track the impacts of these modifications on the training capability. To fill these needs, we created an assortment of macros and global variables.

The creation of 34 macros that allowed us to set ranges for space, staff, and networks based on BCTC size. By establishing these ranges, we could then allow the model to evaluate various combinations in order to determine the best mix. We will discuss these in greater detail when we address our design of experiments.

We created 115 global variables to enable us to 1) track overall throughput from start to finish, 2) track individual entity types, 3) track resource consumption, and 4) track training event progress in terms of time. As we will discuss later in the report, these variables served a critical role in providing real-time progress indicators as well as in facilitating the development of our logic sequences.

3.4.6.4 Model Initialization & Entity Reception

Early in the construction of our model, we discovered the need for a multi-phased approach to model initialization and entity reception, which is what led to our creation of the

various receiving locations previously discussed.   Before we begin our discussion of and references to modeling logic, we should note that Appendix K contains all of our coding sequences in full form. The following figure provides a snapshot of the initialization and entity reception aspect of the model.

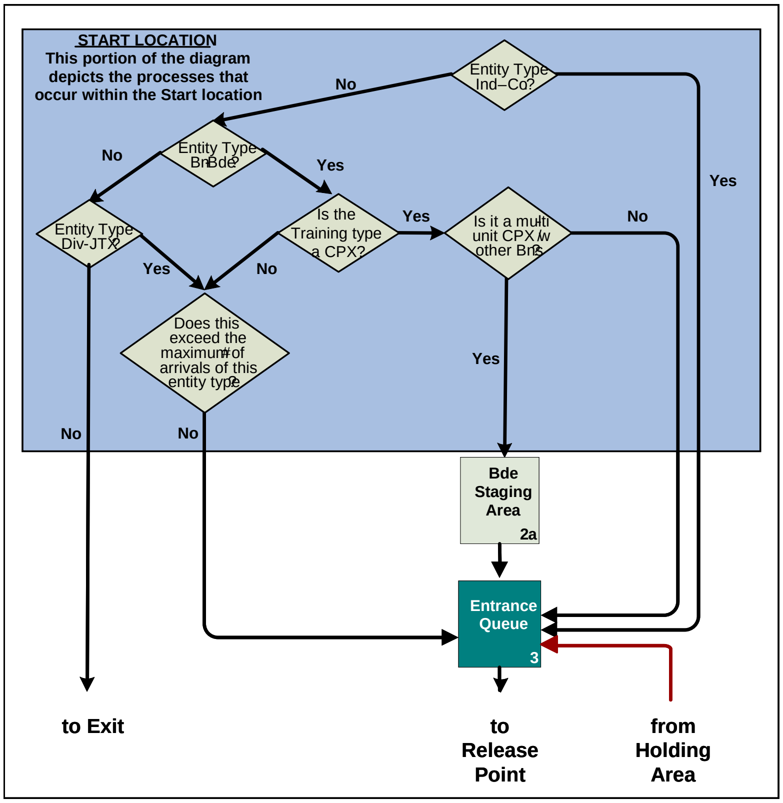

Figure 3.5. Diagram of the Initialization and Entity Reception phase.

The first phase of initialization occurs in the Initialization Logic, which the model uses to set all parameters and macros before actually beginning the simulation. Here, we establish the BCTC size we are modeling and the associated settings for space, staff, and networks (in terms of how much of each is available for use), as well as throughput in terms of how many entities the facility must process. Thus, we have set the conditions in which the model will construct arriving entities and eventually process them.

The second phase involves the entity reception piece, which occurs within the Start, Bde_Staging_Area, and the Entrance_Queue locations. In this phase, the model begins to track entities in the system by incrementing global variables and assign them attributes based on the type of entity they are and the conditions established by the initialization logic. In the cases of particular entities, such as brigades, the model conducts a statistical evaluation to

determine whether or not that entity has arrived to train alone or with one or more battalions. As an aside, we had to account for differentiate between the instances wherein a brigade entity arrives to conduct training on its own versus those occasions on which it arrives to conduct training with its subordinate battalions. Based on our data collection efforts from the field, we developed discrete probability distributions to account for such occasions. When they arise, as statistically determined by the model, the brigade entity proceeds to the Bde_Staging_Area to wait for the required number of battalions before proceeding forward in the model.

The Entrance_Queue location acts purely as a bridge, or conduit that controls the flow of entities into the Release_Point, which is the most complex of our processing locations. The initialization and reception phases occur with the arrival of each individual entity, and end for a particular entity when it enters the Entrance_Queue.

3.4.6.5 Processing Entities (Discussion of Model Logic)

Although some entity processing actually occurs I the reception phase of the model, the complex processing does not begin until an entity enters the Release_Point location. This location represents the actual entry point into the BCTC facility. It is here that the model goes through its most extensive logic process, using initialization conditions and entity attributes developed in the reception phase to determine what type of entity is trying to enter the BCTC to train. Figure 3.6 below provides a simplified look at the logic process the model uses to determine how to deal with entities as they enter the Release_Point.
As the diagram shows, the model first brackets the entity type and then runs a series of checks against the current conditions in the BCTC. Specifically, these checks enable the model to determine whether or not the arriving entity can enter the facility. If conditions permit entry, then the model directs entities either to the MPCR or the RTOC_Bays to conduct training. In the event that existing conditions disallow entry, the model directs the entity to the Holding_Area, which acts as another conduit to facilitate flow. We included a routing to the Exit location to mitigate any chance of ghost entities entering the system.

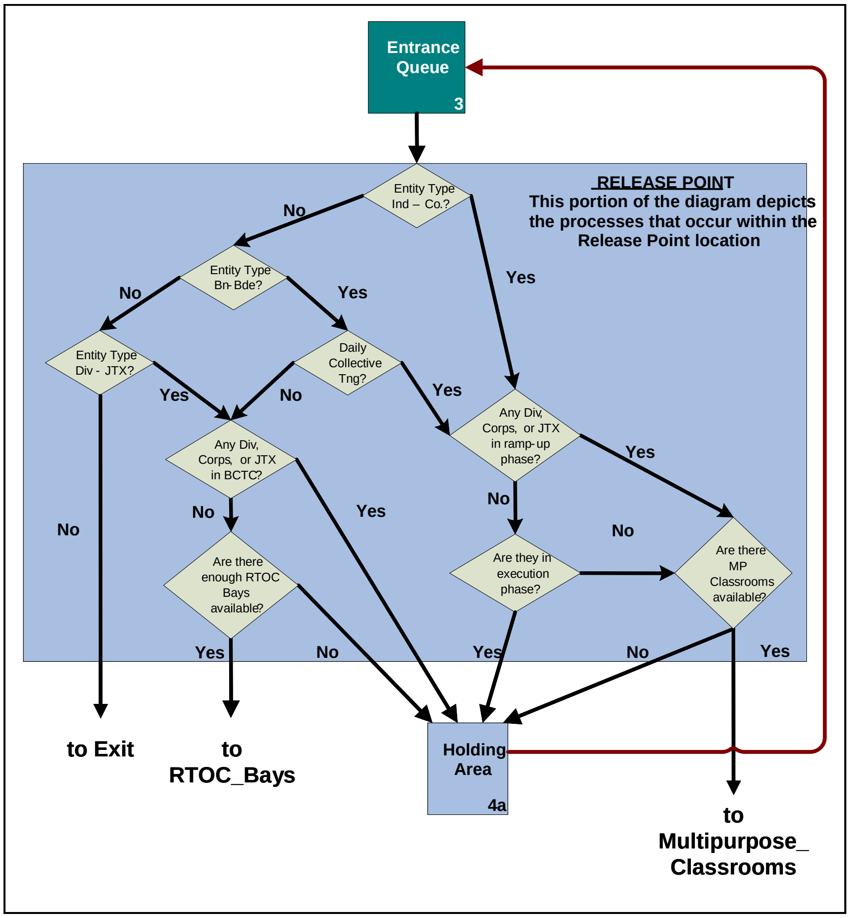

Figure 3.6. Diagram revealing the extent of the processing details that the model executes at the Release Point location.

The Holding_Area location serves to pull entities that cannot enter out of the queue. In short, a failure to enter resulting from existing conditions in the BCTC causes a preemption whereby that entity proceeds to the end of the queue. Leaving them at the Release_Point would complicate matters considerably, as model would wait until the conditions were such that the entity could enter, which consumes time. The Holding_Area allows us to reroute the entities back through the Entrance_Queue and then into the Release_Point again, which allows other. Thus, the each time entities re-enter the Release_Point, the model treats them as new arrivals and reassesses the conditions against their respective attributes. Moreover, since all of the entity attribute initialization occurs prior to the Entrance_Queue, we do not have to worry about the inherent complexities associated with reassigning attributes and resetting global variables that the model has already incremented.

For those entities permitted to enter the BCTC, the model will assign additional attributes and increment global variables to begin the tracking process through the BCTC before directing the entities forward either to the MPCR or the RTOC_Bays. These locations represent the heart of the training capability in the BCTC system. At each, the model executes logic processes similar to those used at the Release_Point, except that it now uses entity attributes, global variables, and BCTC conditions to determine how long an entity stays (based on the type and duration of the training event), what it does while it is there, how many resources it consumes and for how long, and where it goes next. At the remaining locations, AAR_Rooms and the Exit, the model executes similar logic to process entities through the system. The latter serves as a consolidation point at which the final processing occurs.

3.4.6.6 Tracking Training Throughput & BCTC Conditions

Throughout the simulation, we needed ways to track the progress of entities as the model processed them and to track the conditions in the BCTC as they evolved. As mentioned earlier, we used global variables extensively to achieve these effects. In both cases, we incorporated global variables in numerous places within the logic. This allowed us to increment and then decrement the appropriate variables as entities moved through the system and conditions changed. Figure 1.1 provides a visualization of this usage.

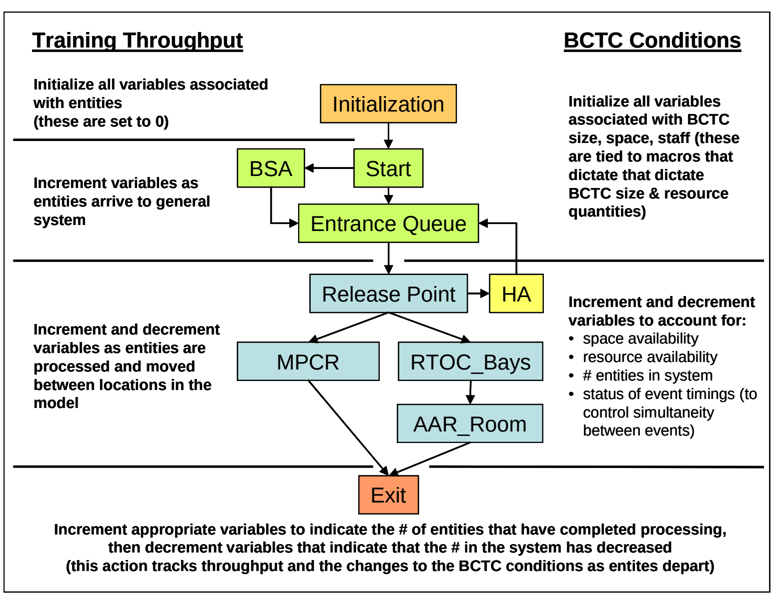

Figure 3.7. Schematic correlating the use of global variables to various stages within the model.

3.4.7. Verification and Validation

3.4.7.1 Verification Methodology

Once we completed the construction of our model it was, as Jensen and Bard (2003, 648) articulate, "necessary to determine whether or not the logic ha[d] been implemented correctly and whether or not the calculations [were] being performed as intended." This constitutes the verification step. We used eight techniques from (Law & Kelton, 2000) to verify our model. These are:

1) Write and debug the program in modules or subprograms;
2) Have multiple subject-matter experts review the model code (e.g., coders and/or program managers);
3) Run the model using various settings of the input parameters and check reasonableness of the output results;
4) Conduct program traces to ensure model is operating as intended;
5) Run the model under simplifying assumptions for which its true characteristics are known;
6) Observe an animation of the simulation;
7) Compute sample statistics for simulation inputs and compare with desired (i.e., historical) statistics; and
8) Use a commercial simulation package to reduce the amount of programming and thereby minimize errors

From the outset of the modeling process, and as the contents of Appendix K reflect, we developed the simulation model in manageable pieces, or modules, developing our logic sequences based on locations within the model. As we completed location modules, we submitted the code sequences to various subject matter experts within the Department of Systems Engineering for them to review. Once we were satisfied with the code within our modules, we then compiled the entire model and began a comprehensive multi-phased debugging process.

The process began with an in-depth comparison of the simulation model to our flow diagrams. This enabled us to step through the model to ensure the logic accurately represented the flow dynamics of the BCTC system. As a result, we discovered, in the cases

of particular locations, we needed to reorder certain logic sequences to more accurately capture system flow and the dichotomy between entity processing and BCTC conditions.

The next phase consisted of an extensive debugging of all programming code, both within the modules and between them, to ensure we had achieved accurate flow dynamics and seamless transitions throughout the model.

The final phases of our debugging occurred once we had the model up and running. It was in this phase that we conducted program traces, observed animation sequences, and compared statistical output. The use of these techniques resulted in some minor restructuring of variables, attributes, and logic sequences to realize the desired effects. In some cases, we discovered that we needed to incorporate new attributes and variables in order to capture effects we had overlooked.

3.4.7.2 Validation Methodology

To validate our model, we applied Law and Kelton's six categories of techniques in order to "establish that [our model's] output data closely resemble the output data that would be expected from the actual system (Law and Kelton, 2000, 279)." They include:

1) Collection of high-quality information and data on the system;
2) Regular interaction with project manager (or stakeholders);
3) Use of an assumptions document and a structured walk-through of the model;
4) Quantitative techniques;
5) Output validation; and
6) Animation (face validation).

For the purposes of redundancy and thoroughness, we utilized each of these techniques in our validation process.

In a macro sense, we sought to validate the model by feeding actual training throughput data and facility specifications from an existing BCTC, which possessed nearly all current state-of-the-art capabilities, into the simulation. This permitted us to run the model for several of our stakeholders and subject matter experts to face-validate flow using animation sequences and more structured walk-throughs of the model, as well as to validate many of the more critical assumptions we made in the modeling process. Once we were satisfied that the model was running properly and was accurately processing training

throughput, we conducted an experiment of 100 runs. After normalizing the results, we compared the model output to the output of the actual BCTC system we imitated, which for our purposes demonstrated we had a valid functioning simulation model.

3.4.8. Designing the Simulation Experiments

3.4.8.1 Goals

In designing our experiments, we sought to ascertain the optimal mix of space, staff, and networks to achieve throughput objectives in the required period of time (one training year, or 235 days) while avoiding excesses in each. Accordingly our design of experiments involved the development of optimization runs using a commercial software package and determination of the right mix of response variables and input factors to compose an objective function.

3.4.8.2 Optimization Tool Used

Pursuant to achieving our optimization goals, we used SimRunner2, which is a commercial software package developed by the ProModel Corporation. SimRunner2 "uses an optimization method based on evolutionary algorithms (Harrell, et al, 286)." Historically, evolutionary algorithms have been successfully applied to difficult optimization problems such as job-shop scheduling and high-performance network design, which are not too dissimilar to the problem we face (Eichler-West, et al, 1999). In essence, after the programmer has developed and coded the desired objective function, the software uses the results of this function to determine which combination of response variables and input factors to try next. It does so by exploring combinations of factors that are not near the proposed solution, which generates a higher probability of locating a global optimal value rather than a local one. The program continues to utilize this basic methodology by "experimenting, analyzing, changing, and repeating the tests until it no longer gets any improvement in the objective function (ProModel Corporation, 1997, 91).

3.4.8.3 Methodology

By virtue of using SimRunner2 as our optimization too, our design of experiments methodology followed a multi-step process, which is centered on the evolutionary algorithms previously discussed and is guided by the software. In short, the stopping rule for the algorithm depends on two parameters specified by the user. These are the "optimization profile" and the "objective function precision."

The optimization profile offers three alternative selections: aggressive, moderate, and cautious. These correspond to three distinct and increasing values of an internally-determined population size and essentially dictate the speed with which the algorithm converges on a solution. An aggressive profile produces a quicker convergence, but the result will have a lower probability of actually being the true global optimal. At the other end, a cautious profile takes a much more detailed approach to testing all possible combinations, thereby converging more slowly but producing a result with a much higher probability of being the true global optimal (ProModel Corporation, 1997). Objective function precision (OFP) is a real number that refers to the degree of precision the user wishes to achieve before the algorithm terminates. Basically, as the experiment unfolds, the algorithm compares the best and average objective functions values relative to the desired OFP in each generation of combinations. If certain criteria are met in a particular generation, the algorithm terminates. Otherwise, it selects and simulates the next of combinations, recomputes the best and average values, and then re-executes the termination test (Law and Kelton, 2000).

Our methodology incorporated both of these parameters to guide our experiments. For each BCTC size, we elected to use all three optimization profiles sequentially, with an objective function precision (or convergence percentage) of 0.01. Figure 3.8 summarizes the functional aspects of our methodology, describing the manner in which we defined broad ranges of macros and then, by exploiting the inherent characteristics of the algorithms for each optimization profile, refined these ranges until we were able to identify a true global optimal.

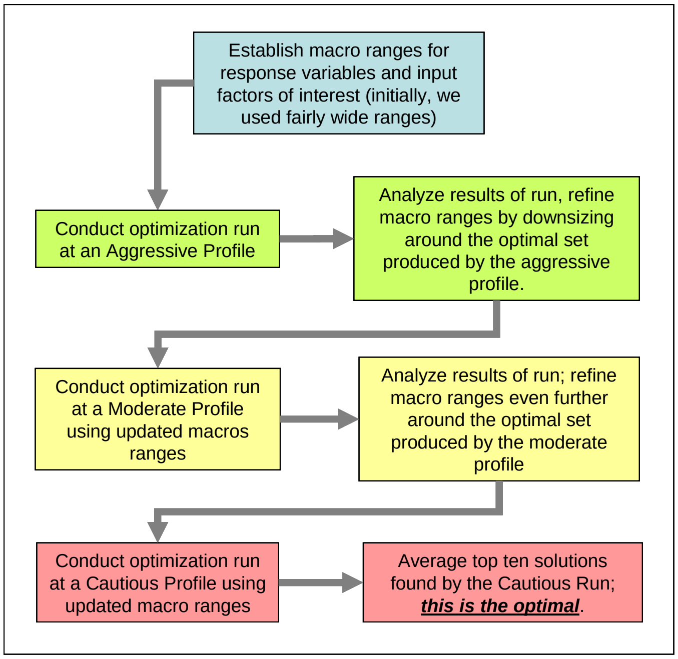

Figure 3.8. Design of experiments methodology.

3.4.8.4 Objective Function

As alluded to previously in this report, the purpose of our objective function was:

to achieve the specified training throughput in one year (235 days) or less by determining the optimal mix of space (classrooms and RTOC Bays), the five staff elements, and networks.

To develop the objective function, SimRunner2 requires that the user specify both response statistics and input factors.

3.4.8.4.1 Response Statistics and Constraints on the System

The response statistics constitute user-selected variables of interest from the simulation model that the objective function will measure during the optimization. Establishing the response statistics is a three-part process. First, the user specifies *how* they want the variable measured by programming the objective function to either minimize or maximize a specific aspect of the variable, or target a specific value or range. Next, the user indicates *what* they want measured in terms of a particular aspect of each variable. SimRunner2 offers six alternative aspects to choose from: total changes to the variable, average time/change, minimum value, maximum value, current value, or average value. Finally, the user allocates an integer-valued weight, or coefficient to each variable, which

indicates the relative levels of importance between variables. The following table depicts how we constructed this portion of our objective function.

Table 12. Response statistics used in the objective (or optimization) function.

Variable of Interest	How Measured	What Aspect is Measured	Weight
V_run_length_days	Target range [220 to 235]	Maximum Value	1
V_num_total_entities_end	Target value [total throughput value based on BCTC size]	Maximum Value	1
V_num_MPCR	Minimize	Maximum Value	1
V_num_RTOC_bays	Minimize	Maximum Value	1
V_num_IT_staff	Minimize	Maximum Value	1
V_num_CT_staff	Minimize	Maximum Value	1
V_num_SimStim_staff	Minimize	Maximum Value	1
V_num_TechSpt_staff	Minimize	Maximum Value	1
V_num_TngSpt_staff	Minimize	Maximum Value	1
V_num_networks	Minimize	Maximum Value	1

As the table shows, we selected those variables that directly correlated to the training capability. We generally sought to minimize the maximum value for these variables, with two exceptions. The maximum-value portion concerns the maximum number of the variable required to achieve throughput in a particular generation of the experiment. We elected to minimize this aspect essentially to obtain the minimum requirements for each and thereby what was critically necessary to achieve throughput objectives without going to excess.

For the two exceptions, we used a target range/value to force the objective function in a certain direction. As is clear from the table, these variables concern the length of time required to achieve throughput and the total throughput level and they generally act as constraints on the system. We had to achieve the total throughput levels within the 235-day year. Accordingly, the target range and value used are directly tied to those values. For the throughput levels, these values were simply the total throughput values reflected in Table 8 on page 30. For the length of time, we wanted to achieve throughput goals within the 235-day period, but did not want to be unrealistic in terms of how quickly we could achieve this. Thus, during the course of our validation phase, we analyzed those runs in which total throughput was achieved and then used the minimum value of 220 days as the lower bound for our target range.

3.4.8.4.2 *Input Factors*

"The input factors are those factors available for testing to see how modifying them will increase or decrease model performance (ProModel Corp., 1997, 36). In other words, they provide a set of values that the program will then plug into the response statistics in various combinations. Recall from section 0 on page 35 that we used macros to establish these sets or ranges of values for an assortment of items.

To create input factors, SimRunner2 requires three pieces of information: the macros of interest, default values for each and then the bounds for the desired range. In our discussion of our optimization methodology in section 3.4.8.3 above, we indicated that, after conducting optimization runs using aggressive and moderate profiles, we refined our macro ranges around the optimal set of values resulting from each particular set of experiments. The input factors are where we execute those refinements. Table 13 below summarizes this information, showing how, with successive runs using increasingly detailed profiles, we modified our macro ranges to identify our global optimal for each BCTC size.

Table 13. Summary of input factors used in the design of experiments.

		Aggressive Profile		Moderate Profile		Cautious Profile	
Size	**Macro**	**Default**	**Range**	**Default**	**Range**	**Default**	**Range**
Large BCTC	MPCR	9	7-12	7	6-8	7	6-7
	RTOC_bays	12	10-15	11	10-12	11	10-11
	IT_Staff	20	17-25	17	15-17	16	15-17
	CT_Staff	22	18-24	18	17-19	18	17-19
	SimStim_Staff	9	6-12	8	7-9	8	7-9
	TechSpt_Staff	8	5-10	7	6-8	7	6-7
	TngSpt_Staff	9	7-12	8	7-9	8	7-8
	Networks	7	4-10	2	5-7	6	5-6
Medium BCTC	MPCR	8	5-10	8	6-8	6	6-7
	RTOC_bays	11	8-14	10	8-12	9	8-9
	IT_Staff	16	10-22	13	12-16	13	12-13
	CT_Staff	16	12-20	16	12-16	13	12-13
	SimStim_Staff	8	6-10	8	6-8	7	6-7
	TechSpt_Staff	7	5-9	6	5-7	6	5-6
	TngSpt_Staff	9	7-11	9	7-9	8	7-8
	Networks	5	4-7	4	4-6	5	4-5
Small BCTC	MPCR	4	3-6	5	3-5	4	3-4
	RTOC_bays	5	4-7	6	4-7	5	4-6
	IT_Staff	9	6-12	11	6-10	7	6-8
	CT_Staff	7	5-9	8	6-9	8	7-9
	SimStim_Staff	5	2-5	5	3-5	4	3-5
	TechSpt_Staff	4	3-6	3	2-5	3	2-4
	TngSpt_Staff	4	3-5	5	3-6	3	3-5
	Networks	4	3-5	4	3-5	3	2-4

3.4.9. Conducting the Simulation Experiments

3.4.9.1 Optimization Runs

As previously mentioned, we executed three optimization runs, one at each profile setting, for each BCTC size. Each optimization run consisted of an unspecified number of experiments, which was determined by how long it took the algorithm to converge. These experiments constituted generations, or a set of runs of the simulation model. For our experiment design, we determined that each generation in a particular optimization run would consist of 30 replications of the simulation. This was for the obvious purposes of normalization based on the central limit theorem. This means that, at the outset of a particular generation, the algorithm would select a combination of the input factors from the established macro ranges for the designated profile, and then execute 30 runs of the simulation utilizing those values.

3.4.9.2 Optimization Results

The optimization runs at each profile setting required various numbers of experiments to achieve a global optimal for each BCTC size. The following table reflects the number of experiments each optimization run required before the algorithm converged on a solution.

Table 14. Total experiments conducted for each optimization run, by BCTC size.

		Optimization Profile		
		Aggressive	**Moderate**	**Cautious**
BCTC Size	**Large**	109	94	260
	Medium	112	178	94
	Small	103	181	161

After conducting these runs, we achieved the results shown in Table 15 for space, staff, and networks for each BCTC size. Recall that these values represent the average of the ten best experiments from the cautious profile runs. Appendices L, M, and N contain all of the output data for large, medium, and small BCTCs respectively.

Table 15. Optimization results.

	Space		Staff						Other
	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# Sim/Stim Staff	# Tech Spt Staff	# Tng Spt Staff	TOTAL Staff	# Networks
Large BCTC	7	11	16	18	8	7	8	100	6
Medium BCTC	6	8	13	16	8	6	8	74	5
Small BCTC	3	5	7	8	4	3	4	33	3

3.4.10. Optimization Results vs. the Base-Case Design

With our optimization runs complete, we could now compare our results against the capabilities provided by the base-case designs. The purpose of this comparison was to answer the intrinsic question we posed in section 3.1, which was: do the requirements identified by the working group provide adequate training capability to achieve the Army's near/long term training strategies and objectives? Table 16 below summarizes the comparison between the optimization results and the base-case designs.

Table 16. Summary of comparison between base-case designs and optimization results.

	Multipurpose Classrooms		RTOC Bays (total interior & exterior)		Total Staff	
	Base Case	Optimization Result	Base Case	Optimization Result	Base Case	Optimization Result
Large BCTC	7	7	15	11	130	100
Medium BCTC	4	6	10	8	87	74
Small BCTC	3	3	5	5	33	33

As the data in the table unequivocally shows, the answer to our intrinsic question is yes; the base-case designs indeed provide enough capability to accommodate annual training event throughput requirements. However, the table also implies that the base-case designs possess excess capabilities as they mandate more space and staff than appears necessary from the simulation results. The only exception is the classroom requirement for the medium facility. The disparity here stems from the scaled way in which the base-case designs were

developed. In truth, the only substantive difference between the large and medium facilities consists of the addition of a corps headquarters and a few support brigades. Moreover, in general the divisional units supported by the medium BCTC typically have a higher density of ABCS systems. If we consider these two things together, the daily individual and daily collective training loads for the medium BCTC are only slightly less than the large BCTC.

Ultimately, the differences reflected in the data in Table 16 beget yet another question about whether or not the base-case designs possess more capability than is necessary.

We looked at the disparities between the base-case designs and our results from two perspectives. First, we considered them from a traditional cost-benefit approach. Although when dealing with training capability, too much is generally better than not enough, we must consider the additional costs that typically follow when dealing with excesses of anything. In this case, costs refer to the impacts of excess space and staff, both financially and otherwise. While we did not conduct any sort of in-depth cost analyses in the general context of this problem (i.e., in terms of square footage costs or staff costs, etc.), we did consider the *prospect* of these costs against the long-term benefits of having excess capability. As part of this analysis, we looked at the anticipated changes in force structure, unit composition, training event types and densities, and the potential need to eventually expand the facilities. In short, do the eventualities of these things outweigh the costs associated with maintaining extra space and accounting for additional staff?

Second, and no less important, we recognized that, given the complexity of this particular stochastic system, there are inherent aspects of variability that we were unable to capture in our model. While our results indicate that lower levels of space and staff can still achieve throughput, they nevertheless represent generalized "best case" minimums. Thus, while the capabilities provided by our optimization results achieve throughput requirements on average, there are a small percentage of occasions in which they will not do to the impacts of variability on the system. These translate to other "costs" viewed from a completely different perspective, which concern the impacts on installation and unit training. "Padding" the training capability by what equates to a little more than one standard deviation will tend to mitigate these effects by allowing the system to adapt to variability.

Chapter 4: Phase 3 - Recommended Design Capabilities

Based on our optimization results and our comparison of these results against the base-case designs, we recommended the BCTC Working Group and Design Board proceed with the base-case designs as the standardized capability templates for future battle command training centers, with the exception that the Board increase the classroom requirement for medium facilities from 4 to 6. Table 17 encapsulates our recommendation.

Table 17. Recommended space and staff levels for the BCTC design template.

	Multipurpose Classrooms	RTOC Bays (total interior & exterior)	Total Staff
Large BCTC	7	15	130
Medium BCTC	6	10	87
Small BCTC	3	5	33

Ultimately, we determined that excess capability in the short term would allow installations to "grow" into them as the Army moves forward with its transformation. Thus, in response to the question posed in the previous section, the aforementioned eventualities indeed outweigh the short-term costs. In particular, we noted that:

- The current force structure is in a state of perpetual change; most indicators show that battle command training will continue to evolve and expand vertically and laterally;
- Unit compositions are also changing, becoming ever-more interspersed with technology and other capabilities that require, among other things, space and people to operate them; and
- The base cases, while seemingly excessive in the physical footprint and staff provisions, provide flexibility to modify or tailor training events, as necessary, to meet unique and evolving training needs, as well as to expand the facilities to accommodate future needs.

From a purely analytical stand point, we also recognized that, while our generalized results are appropriately applied across the broader context of the Army, the effects of variability induced by the unique aspects of particular facilities on individual installations will increase the probability that our "best case" minimums may be insufficient. As previously stated, accounting for this inevitability will help to mitigate its effects.

Chapter 5: Constructing 2-D and 3-D Renditions of a Notional Prototype Facility

5.1 Overview

As part of our original statement of work, we agreed to provide our client with a three-dimensional rendition of a potential prototype facility. The primary reason for this extension of our work was to provide a visualization of what a capabilities-based facility might look like. This, in turn, would serve a partial demonstration of SMART principles in practice.

In this particular case, we initially focused our efforts on modeling and analyzing the core training functions of the BCTC in order to ensure the design templates possessed the requisite training capabilities. Pursuant to this, we can apply these results in the actual design phase of the implemented template solution by reassessing the peripheral supporting functions and capabilities and then designing the actual physical footprint for the facility. In accordance with SMART, we can then adapt a visualization of the “product” prior to committing to an engineering design.

5.2 Development of 2-D Renditions

Our two-dimensional renditions began with the development of concept sketches for large, medium, and small BCTCs using Microsoft Visio. We based these sketches both on the functional requirements matrices developed by the BCTC Working Group (Appendix C) and a notional adaptation created by the USACE Team from Huntsville, AL (Mr. Mark Fleming and Mr. Jim Kelley) that conveyed adjacency requirements and functional relationships within the facility. While not to scale, the sketches combine the results of our training capability assessment for each generic building size with the functional and adjacency requirements, and provide an effective representation of a plausible prototypical facility. Figure 5.1 depicts our concept sketch for a Large BCTC; Appendix O contains sketches for all three facilities sizes.

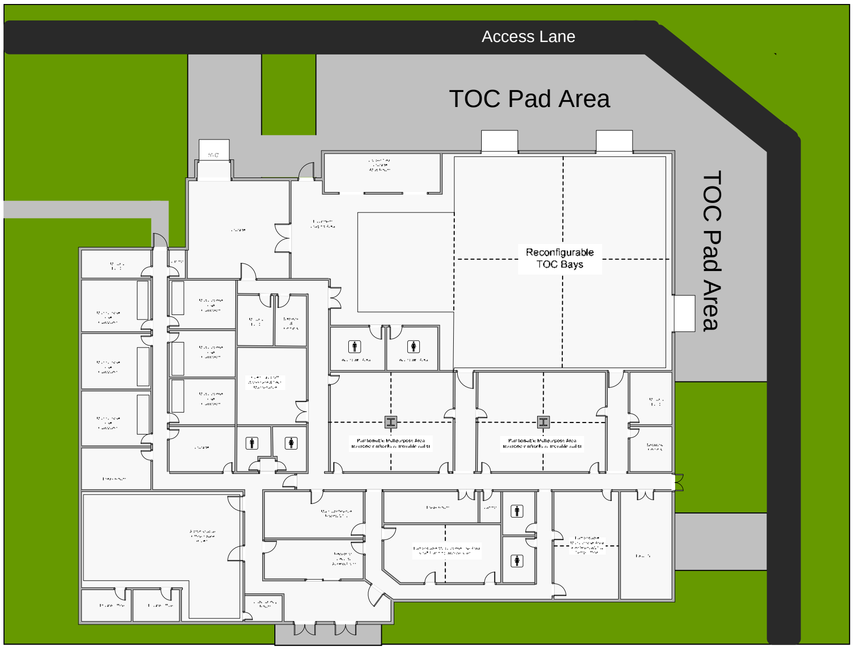

Figure 5.1. MS Visio concept sketch of a Large BCTC, reflecting the fusion of our simulation results with functional and adjacency requirements.

We then provided our concept sketches to the Construction Engineering Research Laboratory (CERL) so they could utilize Facility Composer software to assist in designing an accurate engineering design based on our requirements. "Facility Composer is a suite of criteria and requirements-based facility modeling tools (Engineering Research and Development Center/CERL, 2006)". The purpose of the software package is to:

- Provide a method to effectively and creatively create, specify, and track design criteria/requirements;
- Provide support for architectural programming and project specific criteria/requirements specification during interactive design charrettes, or at the designer's desktop; and
- Support the creative and analytical aspects of architectural conceptual design involving the creation of one or more solutions from the specified criteria/requirements in an intuitive 3D design environment.

In short, CERL provided us with a refined sketch and requirements package that reflected a scaled version of our concept sketch and more accurately reflected the functional

requirements. Moreover, the software made any necessary adjustments to account for any engineering/building code specifications of which we were unaware. The following figure presents an example of a Medium BCTC design provided by CERL.

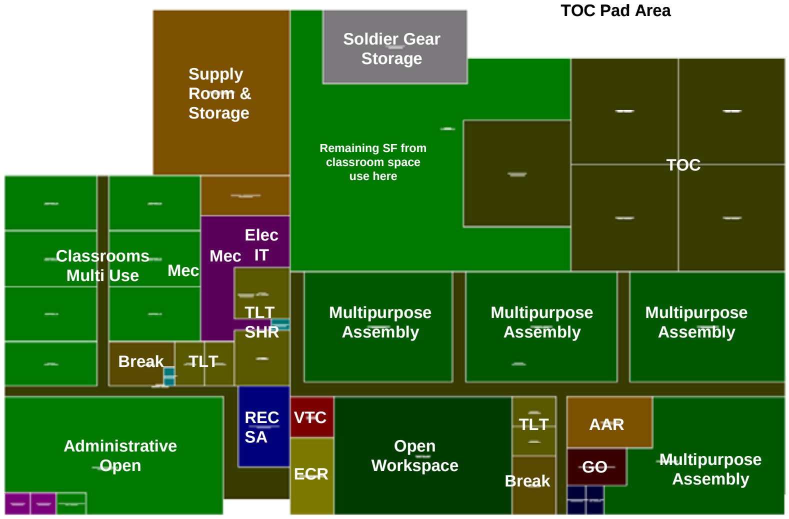

Figure 5.2. A refined 2-D engineering design provided by CERL, which they developed using their *Facility Composer* software package.

5.3 Transition to 3-D Rendition

Our ultimate objective with the three-dimensional rendition was to create a flight model that would allow a user to walk through a simulated BCTC environment. To achieve this, we used a three-step approach consisting of three different software packages.

In the first step, we used Pro Engineer Wildfire 2.0 (Pro/E) to create the shell of the building and then each of the spaces inside. We constructed the building in modules so as to more easily effect any necessary changes or modifications. Once we completed the base of the building and each of the separate rooms inside, to scale, Pro/E enabled us to "assemble" them together. Along with the actual engineering structures of the building, we also used Pro/E to create computer desks, tables, storage shelving, and other visual stimuli to add some depth and character to the rendition.

Step two required that we convert our Pro/E files into flight files (.flt), which we did using Multi-Gen Creator 2.0. This set the conditions for the eventual transfer to a flight package, and also made it possible to import various textures and pre-built pieces of furniture to add a more realistic feel to the model. As part of this step, we converted all Pro/E files, to include the assembled building. Once in Creator, we could simply tell the program to "read"

the external files into a “master file” of model, which it would do by placing each respective piece in the appropriate place within the building. This was critical and extremely useful, as it allowed us to go back into Pro/E to make any adjustments or modifications to existing pieces, or to create new pieces altogether, and then simply re-import the files into Creator and then have them re-read into the master file. Thus, by virtue of how we approached the modeling process, any modifications and changes were quite easy to incorporate.

The third and final step consisted of transferring our flight files from Multi-Gen Creator to Multi-Gen Vega Prime. This was a simple step but a necessary one to create a flight model that we could actually walk through. Appendix O contains various screen shots of the final 3-D model we developed for our client.

Chapter 6: Consideration of Future Capabilities

Recall that one of our original design considerations concerned the integration of future technologies and capabilities. For the purposes of modeling, we did not include such considerations in our primary simulation models for a couple of reasons.

First, the purpose of our simulation was to assess the training capability of the base-case design. Then, as necessary, we could simulate modifications to ensure adequate capability levels were achieved to accommodate throughput requirements. From that perspective, while the inclusion of future capabilities would have lent credibility to the idea of developing a forward-thinking design capable of supporting training well into the future, it was ultimately not necessary to achieve our primary objectives.

Second, including the impacts of evolving technologies not yet fielded (or authorized, in the case of wireless) in the simulation model would have proven very difficult simply because of a general lack of data to validate any potential costs or benefits. Accordingly, the inclusion of such features would have introduced levels of abstraction and hypothesis that would render any results as subjective at best.

Nevertheless, we do believe it an important topic to broach and discuss in the context of this project, as some of these technologies could have very fortuitous impacts on the training environment and capabilities of the BCTC. Accordingly, despite the lack of data and the fact that some capabilities are not yet authorized for use, it still makes sense to consider their eventuality in any current design. Doing so would facilitate a smoother transition in the future and would thereby extend the useful life of any facility designs we develop now. In any case, we should endeavor to develop and field a product that, once complete and fielded, we have not outgrown in the interim. A detailed consideration of future capabilities mitigates these potential pitfalls.

Chapter 7: Contribution of This Work

As with any project, we hoped, over the course of our problem-solving approach, that our work would result in some form of useful and purposeful contribution both to the analytical community and the Army at large. Based on our results and feedback from our clients in the BCSE Directorate and its parent organization in the Army G-3, we believe we have achieved that end. The primary contributions of our work on this project are three-fold.

First, from a modeling perspective, our approach proved to be a unique application of simulation. Usually, simulations are developed and used to evaluate the performance of typical queuing systems. In our case, we successfully applied simulation to a non-standard problem in order to evaluate the levels of capability the system provides in processing its entities. We believe this of some significance, as it demonstrates yet another plausible use of modeling and simulation in the problem solving process.

Second, our development of a functioning and valid simulation model provides the Army with an analytical tool that it currently does not possess. This tool can assist in the design and development of training facilities to ensure they possess the throughput capabilities required of them. We can easily modify the model, as well, to capture changes in training throughput objectives and event types as the Army's force structure and training strategies evolve and grow. Likewise, we can incorporate other considerations such as future technologies, future force systems, costs, and other items of interest as the Army's needs change or grow.

Finally, we have developed a simulation tool that can provide the HQDA G-3, installation training managers, BCTC managers, and unit commanders with a forecasting capability that can enhance decision processes. This capability enables them to identify the potential impacts on annual training resulting from changes in space, staff, and resource levels, untimely changes to annual scheduling, training requirements (particularly increases), and the composition of installations in terms of the numbers of units particular facilities must support. Thus, as an example, if higher-level decision makers elect to pursue cuts in the physical footprint or staffing allocations of a proposed facility, our simulation tool can show the specific impact on training throughput by identifying both the number and types of training events that the facility will complete in a particular year as a result of those changes.

Similarly, if a senior installation commander elects to modify a major collective training event by increasing its duration (of the execution phase), BCTC managers can, with our simulation tool, predict with reasonable accuracy the second and third order impacts on other training events across the year in terms of what can and cannot be achieved or impacts on the training schedules of installation units.

Chapter 8: Conclusions

In September 2005, the BCSE Directorate approached the ORCEN with a challenging problem with potentially far-reaching impacts on the future training environment across the Army. Through the use of a logical problem-solving process (SEMP) that had been successfully applied in numerous projects and studies, coupled with a creative and innovative application of modeling and simulation, we successfully provided our client with the rigorous approach he desired. Even more, our chosen methodologies and approaches therein resulted in contributions to the modeling and simulation community, as well as the development of a multi-faceted tool for the Army that will prove beneficial in the area of facilities and capabilities requirements in the years to come.

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Appendix A: List of Abbreviations

AAR	After Action Review
ABCS	Army Battle Command System
ADTS	Army Digital Training Strategy
AMSO	Army Model and Simulation Office
ARFORGEN	Army Forces Generation Model
BCSE	Battle Command, Simulation, and Experimentation
BCTC	Battle Command Training Center
Bde	Brigade
CAC-CTD	Combined Arms Center – Collective Training Directorate
CATS	Combined Arms Training Strategy
CERL	Construction Engineering Research Laboratory
CP	Command Post
CPX	Command Post Exercise
CTC	Combat Training Center
CT	Collective Training
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
DA	Department of the Army
DAMO	Department of the Army Military Operations
DAMO-TRS	Training Simulations Division of the HQDA G-3
DAMO-SB	Battle Command, Simulation, and Experimentation Division of the HQDA G-3
DOD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and education, Personnel, and Facilities
DTIC	Defense Technical Information Center
FBCB2	Force 21 Battle Command Brigade and Below
FORSCOM	Forces Command
FCS	Future Combat System
G-3	Staff section that supports current and future operations
GW	Global Weight
HBCT	Heavy Brigade Combat Team
HQDA	Headquarters, Department of the Army
IT	Individual Training
JADOCS	Joint Automated Deep Operations Coordination System
JTX	Joint Theater Exercise
KBSC	Korea Battle Simulation Center
LW	Local Weight
MACOM	Major Army Command
MPCR	Multipurpose Classroom
M&S	Modeling and Simulation
MTOE	Modified Tables of Organization and Equipment

NSC	National Simulation Center
OFP	Objective Function Precision
O&O	Operational and Organizational
OR	Operations Research
ORCEN	Operations Research Center
PEO	Program Executive Office
PEO STRI	PEO Simulation, Training and Instrumentation
PLT	Platoon
PRO/E	Pro/Engineer Wildfire 2.0 software
RTOC	Reconfigurable Tactical Operations Center
SBCT	Stryker Brigade Combat Team
SMART	Simulation and Modeling for Acquisition, Requirements and Training
SEMP	Systems Engineering and Management Process
SSP	Simulation Support Plans
STX	Situational Training Exercise
TADSS	Training Aids, Devices, Simulations, and Simulators
TechSpt	Technical Support Staff
TngSpt	Training Support Staff
TOC	Tactical Operations Center
TPFDD	Time-phased Force and Deployment Data
USACE	United States Army Corps of Engineers
USAREUR	United States Army, Europe
USARAK	United States Army, Alaska
USATSC	United States Army Training Support Center
USMA	United States Military Academy
WFX	Warfighter Exercise

Appendix B: Project Proposal and Statement of Work.

Project Title: Army M&S Installation Facilities Layout

Client Organization: Battle Command, Simulation & Experimentation Directorate (DAMO-SB)

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OBJECTIVE OF PROJECT

Problem Statement:

The Army's Transformation to Future Force and the enabling of the Future Combat System (FCS) require the ability to support battle command and embedded training with models and simulations (M&S). Current installation simulation training facilities have been developed over the decades in a manner which maximized their capabilities based on resources, technology, installation requirements, and expertise available at the time the center was built. This has created unique facilities which are non-standard across the Army making and make it more difficult to interoperate. With Network-Centric Warfare being the road to future inter- and intra-service operations, the ability to quickly modify training facilities and interoperate with other facilities in a timely manner is imperative.

Objective:

The objectives of this study are to (a) identify the desired technology and facilities layouts which would enhance inter-installation simulation center operability, (b) develop a baseline technology and facilities layout required for inter-installation simulation center interoperability, and (c) provide a framework for future development. The scope of the work

will include simulation centers utilized to provide virtual simulations capabilities for training or analysis.

TECHNICAL APPROACH (Proposed Work):

For this research, we propose to employ the Systems Engineering Management Process (SEMP) to identify desired technology and facilities layouts which would enhance inter-installation simulation center interoperability. Doing so will provide the basis for identifying essential infrastructure, personnel, hardware, and software required for installation simulation centers. The Systems Engineering Management Process (SEMP) is a robust, deliberate problem solving methodology taught in the Department of Systems Engineering at the United States Military Academy. It has been used widely in a variety of applications, both on military and commercial problems. The SEMP has recently been employed in development of an operational assessment system for Operation Enduring Freedom, in support of the Base Realignment and Closure (BRAC) study group, and to analyze the regional structure of the Army Installation Management Agency.

The first step in this process is assessing current infrastructure, personnel, hardware, and software existing at installation simulation centers. This will begin to produce a listing of potential best practices. We will leverage our efforts in this area with others currently ongoing in the field such as the state-of-the-art facilities currently under development in PACOM. A concurrent step will be to collect information from key stakeholders in the modeling and simulation and training fields to include facilities modeling efforts by SPAWAR and ICT. This will be conducted in a group setting utilizing Group Systems Software as applicable. These efforts will result in a refined definition and more accurate scope of the problem. Capturing insights generated through the process will also be critical in linking this project to the PACOM effort, as well as for anticipating future requirements.

After collecting the information, the ORCEN team will be able to establish the relative ranking of options for current infrastructure, personnel, hardware, and software for installation simulation centers. Based on this knowledge, the team will generate different alternatives for assessing these items. Each of the alternatives can be considered with respect to its interoperability with current installation facilities, the PACOM facility under construction, as well as to future systems. Finally, the team will make recommendations as to the best infrastructure, personnel, hardware, and software characteristics and current/foreseeable technologies.

The Army is transforming to anticipate future threats. Part of that transformation involves implementing a battle command system that is network-centric and compatible/interoperable with modeling and simulation. In order to efficiently achieve that, it is necessary to provide installations with facilities which meet installation training and analytical needs as well as allowing installation to modify their facilities for intra and inter installation interoperability.

Proposed Work (Tasks and Issues):

Tasks to be performed and issues to address:

- Define Problem – M&S Installation Facilities Layout
    - Scope problem with client in terms of options for M&S facilities layouts with regards to infrastructure, personnel, hardware, and software
    - Develop focus and brainstorming questions for needs analysis sessions

    - Identify stakeholders and conduct needs analysis to capture ideas and issues for possible infrastructure, personnel, hardware, and software needs of installation M&S facilities
    - Identify existing and developing installation training and analytical simulation facilities
- Conduct Design and Analysis of Alternatives with Stakeholders
    - Host stakeholder analysis and functional decomposition session(s) with focus and brainstorming questions
    - Identify essential elements of installation training and analytical simulation facilities which sufficiently describe the infrastructure, personnel, hardware, and software make them unique
    - Develop several alternatives to installation training and analytical simulation facilities layouts
    - Frame alternatives, based on stakeholder priorities, for presentation to those stakeholders and AMSO/BCSE
- Recommend and Select Alternatives
    - Prioritize alternatives/elements, based on stakeholder input and a consideration of future requirements
    - Develop recommendations and present to clients and stakeholders
- Implement M&S Installation Facilities Layout
    - Develop M&S Installation Facilities Layout Design(s)

MILESTONES and DELIVERABLES (assumes project start beginning September):

Requirements and Milestones:

Milestone	Tentative Dates
Scope problem with client (systems on which to focus)	14 September 2005
Develop focus and brainstorming questions for needs analysis	28 September 2005
Identify stakeholders for installation simulation facilities layout	28 September 2005
Conduct needs analysis with stakeholders to determine desired capabilities	28 September 2005
Conduct needs analysis with stakeholders (group sessions)	28 October 2005
Identify essential elements of simulation facilities that make them unique and functional	28 October 2005
Complete visitation of installation simulation facilities	14 December 2005
Develop several alternatives for simulation facilities	13 January 2006
Conduct IPR to BCSE to review research to date and alternatives and assessment measures for installation simulation facilities layout	13 January 2006
Develop prioritized list of facilities capabilities and layouts	17 February 2006
Conduct Final Briefing with BCSE with recommendations for installation simulation facilities layout	28 February 2006

Project Deliverables and Due Date*:*

- Interim IPRs: 13 January 2006.
- Final Briefing: 28 February 2006.
- Listing of critical infrastructure, personnel, hardware, and software for installation simulation facilities: 14 March 2006.
- Diagrams of functional installation simulation facilities layouts: 14 March 2006.
- Technical Report: 28 March 2006.

Appendix C: Functional Requirements Matrices

The matrices on the following pages are products of the BCTC Working Group & Design Board.   They were developed over the course of several meetings and site visits spanning more than three months. They primarily represent those functional requirements related to space and the physical footprints for large, medium, and small BCTCs. Moreover, they reflect the various engineering codes and regulations governing the development of training facilities. We used these functional requirements in conjunction with the implied adjacency requirements shown in the notional BCTC diagram (last page of this appendix) to develop our graphical background in our analytical simulation model, as well as in the development of our two and three-dimensional renditions of a notional prototype facility.

Table C. 1. Battle Command Training Capability Requirements Analysis - LARGE BCTC

PHYSICAL SPACE REQUIREMENTS	UM	# OCCUPANTS	UNIQUE REQUIREMENTS	Type of Space	ACTS ALLOW GSF	GSF	REMARKS
Facility Supports a CORPs size unit. (Average daily throughout = 592)	SF	627	Facility occupancy ranges from the BCTC staff (130 daily) to 800 personnel during a Corps level Warfighter exercise. Average GOV Staff = XX; Average CONT Staff = XX; Average Training Audience = 627. (Could be accomodated in a Campus like environment)				
Private Offices (Director & Deputy)	SF	2	Director's and Deputy's office is used for visitor conferences and small meetings of up to 7 personnel.	PRIV OFF	162.0	324	
Executive Conference Rooms	SF	3 X 30	During events this room will be used by senior exercise staff and general officers. This CR needs up to date audio visual aids and telecommunications. This room should also have the capability of showing the simulation.	SP CLASSRM	500.0	1,500	
VTC	SF	25	Secure VTC	SP CLASSRM	500.0	500	
After Action Review	SF	100	The AAR (after action review) room is the location where the formal debriefing of the training event takes place. I n a Corps level event, this room needs to seat at least 100 people. Attendees are the commanders and primary staffs of the involved units (Corps +2-3 Divisions). This room should be fully audio visually equipped to include the ability to show the simulation and live video.	CLSSRM	14.5	1,600	
HICON (Higher Control)	SF	0	Higher control is a group of personnel that roleplay the higher headquarters and in some cases the flank units of the training unit in a simulation supported training event. This group normally works in a large workcell. This room needs space for 6 computer workstations, simulation LAN, telphones fax machines, copy machines and a small briefing area.	ADMIN OPEN	162.0	0	
Classrooms, large	SF	627	Cable trays, raised floor. Classrooms must be wired for simulations support and for C4I connectivity. Basic classroom audiovisual capability, movable walls, ability to temporarily attach maps, posters, etc. to walls. Classroom may be used as traditional classroom or for digital training. With digital training the requirement exists to place C4I devices in the classroom. Use 20 C4I devices as a target figure for a large classroom. C4I devices (if organic to unit) may require non-standard power. Classroom may also be used for AAR overflow.	CLSSRM	52.2	32,729	
Classrooms, special	N/A	N/A	Cable trays, raised floor				
Administrative Offices	SF	84	Facility occupancy ranges from the BCTC staff 125 daily. Normal specifications for admin use area. Must house at least 4 computer modules with space for filing, copy machine, fax machines, telephones , LAN connectivity	ADMIN OPEN	162.0	18,792	
Reception, Security Access point	SF	82	Located at main entrance to facility. Telephone, LAN connectivity, PA system, oversized desk space for rosters, access documents, and badge storage. Badge production with photographic capability. Protective glass at entrance	ADMIN OPEN	14.5	1,189	Based on BCTC average staff @ 125

Work Spaces, Open	SF	44	Cable trays, raised floor This is the office and workspace for the contractors in support of the BCTC effort to be used on a daily basis. There will be approximately 44 contractors (plus management overhead) for a large facility for constructive simulation training and support. Additionally there will be approximately 12 contract personnel to support digital training. Digital training and constructive training supported event should / could be in the same facility.	ADMIN OPEN	162.0	7,128	
Work Cell Spaces, Private	SF	2	Cable trays, raised floor: This space would be occupied by contract management and possibly COR.	ADMIN PRIV	162.0	324	
Wide Doors @ Hallways			roller tables with pre-wired equipment sets	COMMON			
Supply Room/Storage	SF	627	Overall facility Storage for tables, chairs, computer shipping cases (large, multiple computers, screens, and printers), mapboards, easels, movable screens, modular furniture, etc. Additional secure storage area for secure devices (KG / KY) and for classified hard drives.	SUPPLY/STORAGE	17.4	10,910	Assumes 592PN per Day Average Load
Loading Dock		*	Forklift and pallets				Included in Supply/Storage GSF
Break Rooms	SF	6x45	Refrigerator, sink, microwave, vending, phones, television. Lounge type furniture w/ tables and with seating for 45 personnel. [Population during a major event can be approx 700 personel in the BCTC facility].	COMMON	8.7	2,349	
Male/Female Latrines	SF	627	Shower area	COMMON	8.3	5,204	
Janitor Closets	SF	627	Supply Storage: storage for admin supplies and technical supplies, instruments, etc.	SUPPLY/STORAGE	0.3	188	
Soldier gear storage (mud room)	SF	627	temporary storage of coats, web gear, etc. Should have wall hooks for LBE and cold wx gear. Floor should have a water drain so that room can be hosed down when cleaned.	SUPPLY/STORAGE	8.0	5,016	
Secure Operations/Storage	SF	6	TACSIM	SPECIAL	162.0	972	
UPS for core functions	power/ time	*	The UPS is provided for the technical control area where the simulation processors are located. The purpose of the UPS is to allow the simulation to be shut down "gracefully" and controlled in the event of a major power failure. The UPS should provide full power to the technical areas for a minimum of 30 minutes.				
Special computer furniture		*	need storage for this furniture to support multi use space. Modular and ergonomically designed computer workstations. All should be movable and recongigurable. This type furniture would be used in the office and staff work areas. The unit workcells will need both computer modules and table / chair combinations				

Network Infrastructure (routers, hubs, switches, cabling or wireless)		*	The network infrastructure extends throughout the facility into all office, admin, work spaces and workcells. The nexus of the infrastructure is the tech control area whih houses most of the proessors and servers. Hubs and routers are distributed throughout the infrastructure as needed to ensure total connectivity.				3250
Reconfigurable TOC	SF	3 BDE TOCs or 6 BN TOCs	Overhead cable trays, floor mounted covered power drops. The reconfigurable TOCs are areas within the BCTC facility that can be used to simulate a unit TOC complete with C4I and communications equipment. The area must have suffiient floor space to replicate all of the cells in the TOC and the organic equipment (C4I and communications).	SUPPLY/STORAGE	3,250.0	19,500	Assumes BN TOC @ Schofield of 3250SF
GO Office area/Multi Use Conference	SF	4	2 computer workstations able to receive the simulation via the LAN. GO furniture with a conference table. Telephones and audio visual presentation equipment	CONF	544.0	544	
Multi Purpose Assembly & Staging Area	SF	627	This area is where the unit and exercise workcells are located. All areas should have overhead cable trays and floor mounted covered power drops. Each workcell will have both simulation computers (workstations) and C4I equipments. All walls should be movable as the space requirement for the workcells varies with the type workcell.See selected simulation control plans for workcell description and requirements	CLSSRM	52.2	31,320	
MECH/ELEC @ 3%					0.03	4,203	
					SUBTTL	140,089	
					GRNDTTL	**144,292**	42205433.99

TYPE OF SPACE	**UM**	**ALLOW**	**SOURCE**	
Office	**GSF**	**162/PN**	**ACTS (61050)**	
Multi Purpose Classroom	**NSF**	***36/PN**	**ACTS**	
Supply/STORAGE	**NSF**	***12/PN**	**Assumed from ACTS General Purpose Supply Category**	
AAR Fixed Seating Auditorium	**NSF**	**10/PN**	**AR405-70, Table D-4**	
Conference Rooms	**GSF**	**See Note**	**AR405-70, Table D-4**	
Reception Area	**GSF**	**14.5/PN**	**AR405-70, Table D-4**	
Latrines	**NSF**	***5.7/PN**	**ACTS (17119)**	
Janitor Closet	**NSF**	***0.2/PN**	**ACTS (17119)**	
Breakroom/Lounge	**NSF**	***6/PN**	**ACTS (17119)**	
Soldier Gear Storage	**GSF**	**8/PN**	**AR405-70, Table D-3**	
*** = NET SF times 1.45 Net-to-Gross Ratio**	**SF**			
Reconfig TOC	**SF**	**3250/BN**	**SCHOFIELD RTOC size, incl circulation & staging**	
POV Parking	**SP**	**60%**	**Admin assigned staff**	79.2
	SP	**25%**	**Theater seats, assumes student daily load.**	156.75
			TOTAL POV PARKING	**236**

Table C. 2. Battle Command Training Capabilities Requirements Analysis - MEDIUM BCTC.

PHYSICAL SPACE REQUIREMENTS	UM	# OCCUPANTS	UNIQUE REQUIREMENTS	Type of Space	ACTS ALLOW GSF	GSF	REMARKS
Facility Supports a DIV size unit. (Average daily throughout = 388)	SF	388	Facility occupancy ranges from the BCTC staff 87 daily to XXX personnel during a Division level Warfighter exercise. Average GOV Staff = XX; Average CONT Staff = XX; Average Training Audience = 388.(Could be accomodated in a Campus like environment)				
Private Offices (Director & Deputy)	SF	2	Director's and Deputy's office is used for visitor conferences and small meetings of up to 7 personnel.	PRIV OFF	162	324	
Executive Conference Rooms	SF	2 X 30	During events this room will be used by senior exercise staff and general officers. This CR needs up to date audio visual aids and telecommunications. This room should also have the capability of showing the simulation.	SP CLASSRM	500	1000	
VTC	SF	25	Secure VTC	SP CLASSRM	500	500	
After Action Review	SF	80	The AAR (after action review) room is the location where the formal debriefing of the training event takes place. I n a Corps level event, this room needs to seat at least 80 people. Attendees are the commanders and primary staffs of the involved units (Corps +2-3 Divisions). This room should be fully audio visually equipped to include the ability to show the simulation and live video.	CLSSRM	14.5	1310	
HICON (Higher Control)	SF	0	Higher control is a group of personnel that roleplay the higher headquarters and in some cases the flank units of the training unit in a simulation supported training event. This group normally works in a large workcell. This room needs space for 6 computer workstations, simulation LAN, telphones fax machines, copy machines and a small briefing area.	ADMIN OPEN	162	0	Included in classroom requirement.
Classrooms, Medium	SF	388	Cable trays, raised floor. Classrooms must be wired for simulations support and for C4I connectivity. Basic classroom audiovisual capability, movable walls, ability to temporarily attach maps, posters, etc. to walls. Classroom may be used as traditional classroom or for digital training. With digital training the requirement exists to place C4I devices in the classroom. Use 20 C4I devices as a target figure for a medium classroom. C4I devices (if organic to unit) may require non-standard power. Classroom may also be used for AAR overflow.	CLSSRM	52.2	20253.6	
Classrooms, special	N/A	N/A	Cable trays, raised floor				
Administrative Offices	SF	45	Facility occupancy ranges from the BCTC staff 72 daily. Normal specifications for admin use area. Must house at least 4 computer modules with space for filing, copy machine, fax machines, telephones , LAN connectivity	ADMIN OPEN	162	7290	
Reception, Security Access point	SF	87	located at main entrance to facility. Telephone, LAN connectivity, PA system, oversized desk space for rosters, access documents, and badge storage. Badge production with photographic capability. Protective glass at entrance	ADMIN OPEN	14.5	1261.5	Based on BCTC average staff @ 87

Work Spaces, Open	SF	38	Cable trays, raised floor This is the office and workspace for the contractors in support of the BCTC effort to be used on a daily basis. There will be approximately 35 contractors (plus management overhead) for a large facility for constructive simulation training and support. Additionally there will be approximately 12 contract personnel to support digital training. Digital training and constructive training supported event should / could be in the same facility.	ADMIN OPEN	162	6156	Need to validate number of contractor work areas.
Work Cell Spaces, Private	SF	2	Cable trays, raised floor: This space would be occupied by contract management and possibly COR.	ADMIN PRIV	162	324	
Wide Doors @ Hallways			roller tables with pre-wired equipment sets	COMMON			
Supply Room/Storage	SF	388	Overall facility Storage for tables, chairs, computer shipping cases (large, multiple computers, screens, and printers), mapboards, easels, movable screens, modular furniture, etc. Additional secure storage area for secure devices (KG / KY) and for classified hard drives.	SUPPLY/ STORAGE	17.4	6751.2	Assumes 487PN per Day Average Load
Loading Dock		*	Forklift and pallets				Included in Supply Room/Storage
Break Rooms	SF	180	Refrigerator, sink, microwave, vending, phones, television. Lounge type furniture w/ tables and with seating for 45 personnel. [Population during a major event can be approx 844 personel in the BCTC facility]. (4ea @ 45PN/ea)	COMMON	8.7	1566	
Male/Female Latrines	SF	388	Shower area	COMMON	8.3	3220.4	
Janitor Closets	SF	388	Supply Storage: storage for admin supplies and technical supplies, instruments, etc.	SUPPLY/ STORAGE	0.3	116.4	
Soldier gear storage (mud room)	SF	388	temporary storage of coats, web gear, etc. Should have wall hooks for LBE and cold wx gear. Floor should have a water drain so that room can be hosed down when cleaned.	SUPPLY/ STORAGE	8	3104	
Secure Operations/Storage	SF	6	TACSIM	SPECIAL	162	972	
UPS for core functions	power/ time		The UPS is provided for the technical control area where the simulation processors are located. The purpose of the UPS is to allow the simulation to be shut down "gracefully" and controlled in the event of a major power failure. The UPS should provide full power to the technical areas for a minimum of 30 minutes.				
Special computer furniture			need storage for this furniture to support multi use space. Modular and ergonomically designed computer workstations. All should be movable and recongigurable. This type furniture would be used in the office and staff work areas. The unit workcells will need both computer modules and table / chair combinations				

Network Infrastructure (routers, hubs, switches, cabling or wireless)			The network infrastructure extends throughout the facility into all office, admin, work spaces and workcells. The nexus of the infrastructure is the tech control area whih houses most of the proessors and servers. Hubs and routers are distributed throughout the infrastructure as needed to ensure total connectivity.				
Reconfigurable TOC	SF	2 BDE TOCs or 4 BN TOCs	overhead cable trays, floor mounted covered power drops. The reconfigurable TOCs are areas within the BCTC facility that can be used to simulate a unit TOC complete with C4I and communications equipment. The area must have suffiient floor space to replicate all of the cells in the TOC and the organic equipment (C4I and communications).	SUPPLY/ STORAGE	3250	13000	Assumes BN TOC @ Schofield of 3250SF
GO Office area/Multi Use Conference	SF	4	2 computer workstations able to receive the simulation via the LAN. GO furniture with a conference table. Telephones and audio visual presentation equipment	CONF	162	648	
Multi Purpose Assembly & Staging Area	SF	388	This area is where the unit and exercise workcells are located. All areas should have overhead cable trays and floor mounted covered power drops. Each workcell will have both simulation computers (workstations) and C4I equipments. All walls should be movable as the space requirement for the workcells varies with the type workcell.See selected simulation control plans for workcell description and requirements	CLSSRM	52.2	20253.6	
MECH/ELEC @ 3%					0.03	2641.521	
					SUBTTL	88050.7	
					GRNDTTL	**90692.221**	26527474.64

TYPE OF SPACE	**UM**	**ALLOW**	**SOURCE**	
Office	**GSF**	**162/PN**	**ACTS (61050)**	
Multi Purpose Classroom	**NSF**	***36/PN**	**ACTS**	
Supply/STORAGE	**NSF**	***12/PN**	**Assumed from ACTS General Purpose Supply Category**	
AAR Fixed Seating Auditorium	**NSF**	**10/PN**	**AR405-70, Table D-4**	
Conference Rooms	**GSF**	**See Note**	**AR405-70, Table D-4**	
Reception Area	**GSF**	**14.5/PN**	**AR405-70, Table D-4**	
Latrines	**NSF**	***5.7/PN**	**ACTS (17119)**	
Janitor Closet	**NSF**	***0.2/PN**	**ACTS (17119)**	
Breakroom/Lounge	**NSF**	***6/PN**	**ACTS (17119)**	
Soldier Gear Storage	**GSF**	**8/PN**	**AR405-70, Table D-3**	
*** = NET SF times 1.45 Net-to-Gross Ratio**	**SF**			
Reconfig TOC	**SF**	**3250/BN**	**SCHOFIELD RTOC size**	
POV Parking	**SP**	**60%**	**Admin assigned staff**	52.2
	SP	**25%**	**Theater seats, assumes student daily load.**	97
			TOTAL POV PARKING	**149**

Table C. 3. Battle Command Training Capabilities Requirements Analysis - SMALL BCTC.

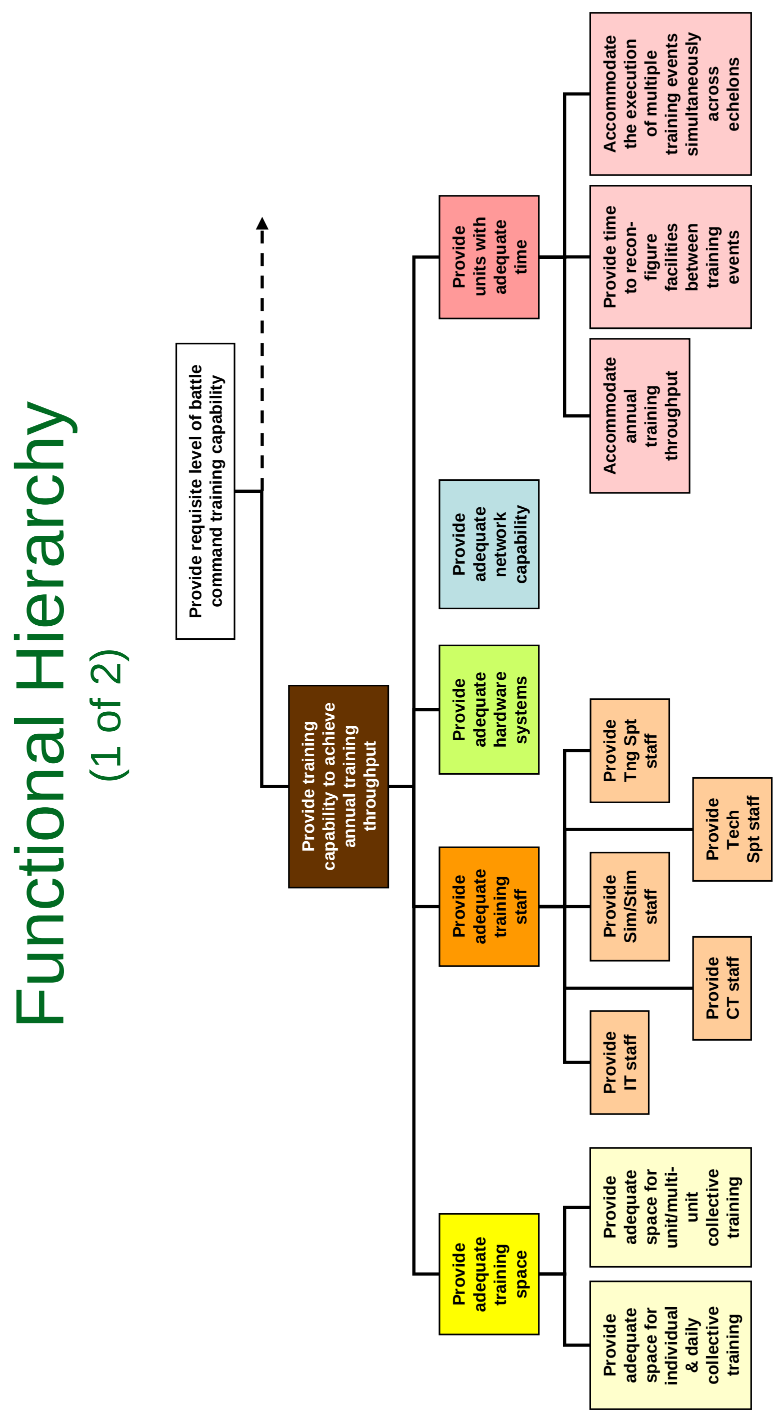
PHYSICAL SPACE REQUIREMENTS	UM	# OCCUPANTS	UNIQUE REQUIREMENTS	Type of Space	ACTS ALLOW GSF	GSF	REMARKS
Facility Supports a BDE size unit. (Average daily throughout = 188)	SF	188	Facility occupancy ranges from the BCTC staff (33 daily) to 165 personnel during a Brigade level Warfighter exercise. (Could be accomodated in a Campus like environment) Average GOV Staff = XX; Average CONT Staff = XX; Average Training Audience = 188.				
Private Offices (Director & Deputy)	SF	2	Director's and Deputy's office is used for visitor conferences and small meetings of up to 7 personnel.	PRIV OFF	162	324	Criteria says use conference room when available.
Executive Conference Rooms	SF	30	During events this room will be used by senior exercise staff and general officers. This CR needs up to date audio visual aids and telecommunications. This room should also have the capability of showing the simulation.	SP CLASSRM	500	500	
VTC	SF	25	Secure VTC	SP CLASSRM	500	500	
After Action Review	SF	60	The AAR (after action review) room is the location where the formal debriefing of the training event takes place. I n a Corps level event, this room needs to seat at least 100 people. Attendees are the commanders and primary staffs of the involved units (Corps +2-3 Divisions). This room should be fully audio visually equipped to include the ability to show the simulation and live video.	CLSSRM	14.5	870	Assumes 50 PN average participation, others from remote classrooms
HICON (Higher Control)	SF	0	Higher control is a group of personnel that roleplay the higher headquarters and in some cases the flank units of the training unit in a simulation supported training event. This group normally works in a large workcell. This room needs space for 6 computer workstations, simulation LAN, telphones fax machines, copy machines and a small briefing area.	ADMIN OPEN	162	0	
Classrooms, Multi Use	SF	165	Cable trays, raised floor. Classrooms must be wired for simulations support and for C4I connectivity. Basic classroom audiovisual capability, movable walls, ability to temporarily attach maps, posters, etc. to walls. Classroom may be used as traditional classroom or for digital training. With digital training the requirement exists to place C4I devices in the classroom. Use 20 C4I devices as a target figure for a small classroom. C4I devices (if organic to unit) may require non-standard power.	CLSSRM	52.2	8613	Assumes average daily throughput for training.
Classrooms, special	N/A	N/A	Cable trays, raised floor				
Administrative Offices,	SF	16	Facility occupancy ranges from the BCTC staff 5 to 16 daily. Normal specifications for admin use area. Must house at least 4 computer modules with space for filing, copy machine, fax machines, telephones , LAN connectivity	ADMIN OPEN	162	2592	
Reception, Security Access point	SF	1	located at main entrance to facility. Telephone, LAN connectivity, PA system, oversized desk space for rosters, access documents, and badge storage. Badge production with photographic capability. Protective glass at entrance	ADMIN OPEN	14.5	478.5	Based on BCTC average staff @ 33

Work Spaces, Open	SF	12	Cable trays, raised floor This is the office and workspace for the contractors in support of the BCTC effort to be used on a daily basis. There will be approximately 44 contractors (plus management overhead) for a large facility for constructive simulation training and support. Additionally there will be approximately 12 contract personnel to support digital training. Digital training and constructive training supported event should / could be in the same facility.	ADMIN OPEN	162	1944	
Work Cell Spaces, Private	SF	2	Cable trays, raised floor: This space would be occupied by contract management and possibly COR.	ADMIN PRIV	162	324	
Wide Doors @ Hallways			roller tables with pre-wired equipment sets	COMMON			
Supply Room/Storage	SF	188	Overall facility Storage for tables, chairs, computer shipping cases (large, multiple computers, screens, and printers), mapboards, easels, movable screens, modular furniture, etc. Additional secure storage area for secure devices (KG / KY) and for classified hard drives.	SUPPLY/STORAGE	17.4	3271.2	Assumes 232PN per Day Average Load
Loading Dock		*	Forklift and pallets				* Included in Supply/Storage GSF
Break Rooms	SF	2x45	Refrigerator, sink, microwave, vending, phones, television. Lounge type furniture w/ tables and with seating for 45 personnel. [Population during a major event can be approx 200 personnel in the BCTC facility].	COMMON	8.7	783	Assumes 45% of total students take breaks at one time (200x45%)=90.
Male/Female Latrines	SF	188	Shower area	COMMON	8.3	1560.4	
Janitor Closets	SF	188	Supply Storage: storage for admin supplies and technical supplies, instruments, etc.	SUPPLY/STORAGE	0.3	56.4	
Soldier gear storage (mud room)	SF	188	temporary storage of coats, web gear, etc. Should have wall hooks for LBE and cold wx gear. Floor should have a water drain so that room can be hosed down when cleaned.	SUPPLY/STORAGE	8	1504	
SCIF	SF	0	Only at Large BCTC	SPECIAL	0	0	Not Allowed
UPS for core functions	power / time		The UPS is provided for the technical control area where the simulation processors are located. The purpose of the UPS is to allow the simulation to be shut down "gracefully" and controlled in the event of a major power failure. The UPS should provide full power to the technical areas for a minimum of 30 minutes.		0	0	
Special computer furniture			need storage for this furniture to support multi use space. Modular and ergonomically designed computer workstations. All should be movable and recongigurable. This type furniture would be used in the office and staff work areas. The unit workcells will need both computer modules and table / chair combinations		0	0	
Network Infrastructure (routers, hubs, switches, cabling or wireless)			The network infrastructure extends throughout the facility into all office, admin, work spaces and workcells. The nexus of the infrastructure is the tech control area whih houses most of the proessors and servers. Hubs and routers are distributed throughout the infrastructure as needed to ensure total connectivity.		0	0	

Reconfigurable TOC	SF	1 BDE TOCs or 2 BN TOCs	overhead cable trays, floor mounted covered power drops. The reconfigurable TOCs are areas within the BCTC facility that can be used to simulate a unit TOC complete with C4I and communications equipment. The area must have suffiient floor space to replicate all of the cells in the TOC and the organic equipment (C4I and communications).	SUPPLY/STORAGE	3250	6500	Assumes BN TOC @ Schofield of 3250SF
EXCON Area, Exercises	SF	30	overhead cable trays, floor mounted covered power drops. This area houses the personnel that control the overall exercise by determining the events, force status, weather, and all other factors used to create the desired conditions for the training objectives. This is the area where"magic" is used to control activities and forces within the simulation. Space should include 6 simulation computer stations, wall maps and charts, electronic displays, C4I connectivity and C4I hardware, and communications systems.	ADMIN OPEN	162	4860	
GO Office area/Multi Use Conference	SF	2	2 computer workstations able to receive the simulation via the LAN. GO furniture with a conference table. Telephones and audio visual presentation equipment	ADMIN PRIV	162	324	
Multi Purpose Assembly & Staging Area, Work Area	SF	188	This area is where the unit and exercise workcells are located. All areas should have overhead cable trays and floor mounted covered power drops. Each workcell will have both simulation computers (workstations) and C4I equipments. All walls should be movable as the space requirement for the workcells varies with the type workcell.See selected simulation control plans for workcell description and requirements	CLSSRM	52.2	9813.6	
MECH/ELEC @ 7%					0.07	3137.267	
					SUBTTLI GSF	**44818.1**	
					GRNDTTL	**47955.367**	14026944.85

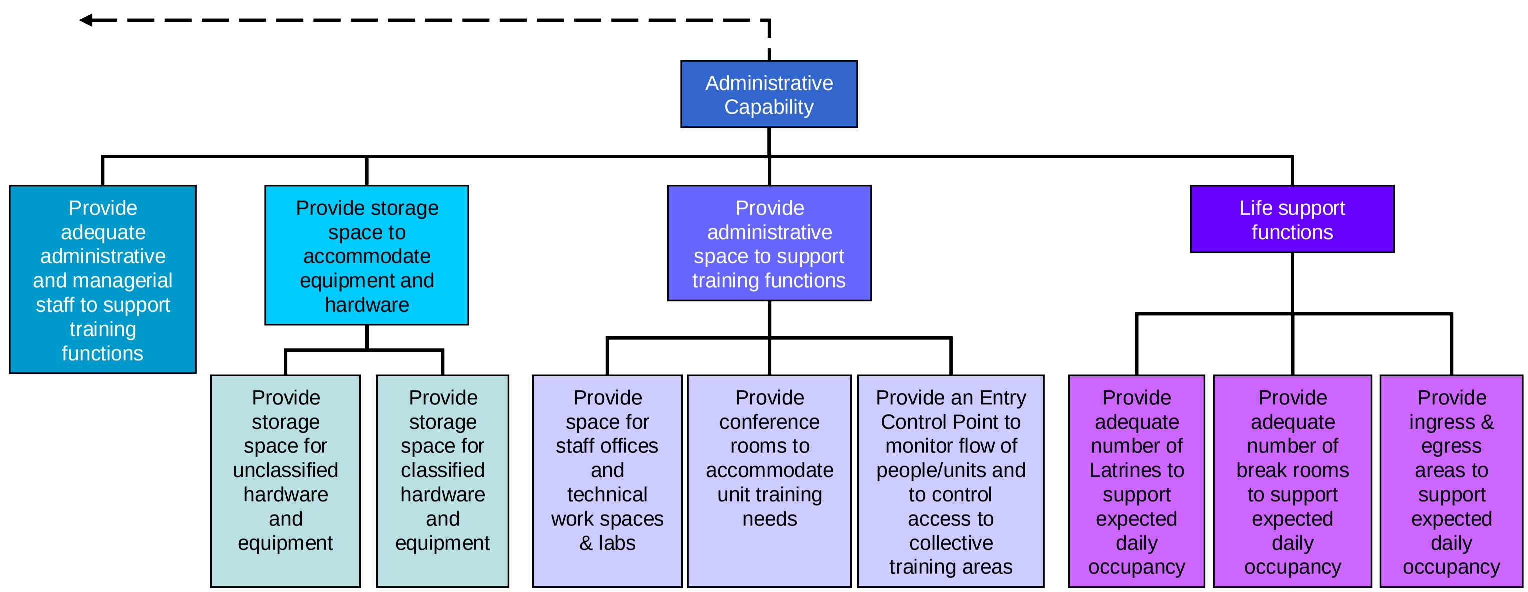
TYPE OF SPACE	**UM**	**ALLOW**	**SOURCE**	
Office	**GSF**	**162/PN**	**ACTS (61050)**	
Multi Purpose	**NSF**	***36/PN**	**ACTS**	
Supply/STORAGE	**NSF**	***12/PN**	**Assumed from ACTS General Purpose Supply Category**	
AAR Fixed Seating Auditorium	**NSF**	**10/PN**	**AR405-70, Table D-4**	
Conference Rooms	**GSF**	**See Note**	**AR405-70, Table D-4**	
Reception Area	**GSF**	**14.5/PN**	**AR405-70, Table D-4**	
Latrines	**NSF**	***5.7/PN**	**ACTS (17119)**	
Janitor Closet	**NSF**	***0.2/PN**	**ACTS (17119)**	
Breakroom/Lounge	**NSF**	***6/PN**	**ACTS (17119)**	
Soldier Gear Storage	**GSF**	**8/PN**	**AR405-70, Table D-3**	
*** = NET SF times 1.45 Net-to-Gross Ratio**	**SF**			
Reconfig TOC	**SF**	**3250/BN**	**SCHOFIELD RTOC size**	
POV Parking	**SP**	**60%**	**Admin assigned staff**	19.2
	SP	**25%**	**Theater seats, assumes student daily load.**	47
			TOTAL POV PARKING	**66**

Appendix D: Functional & Value Hierarchies



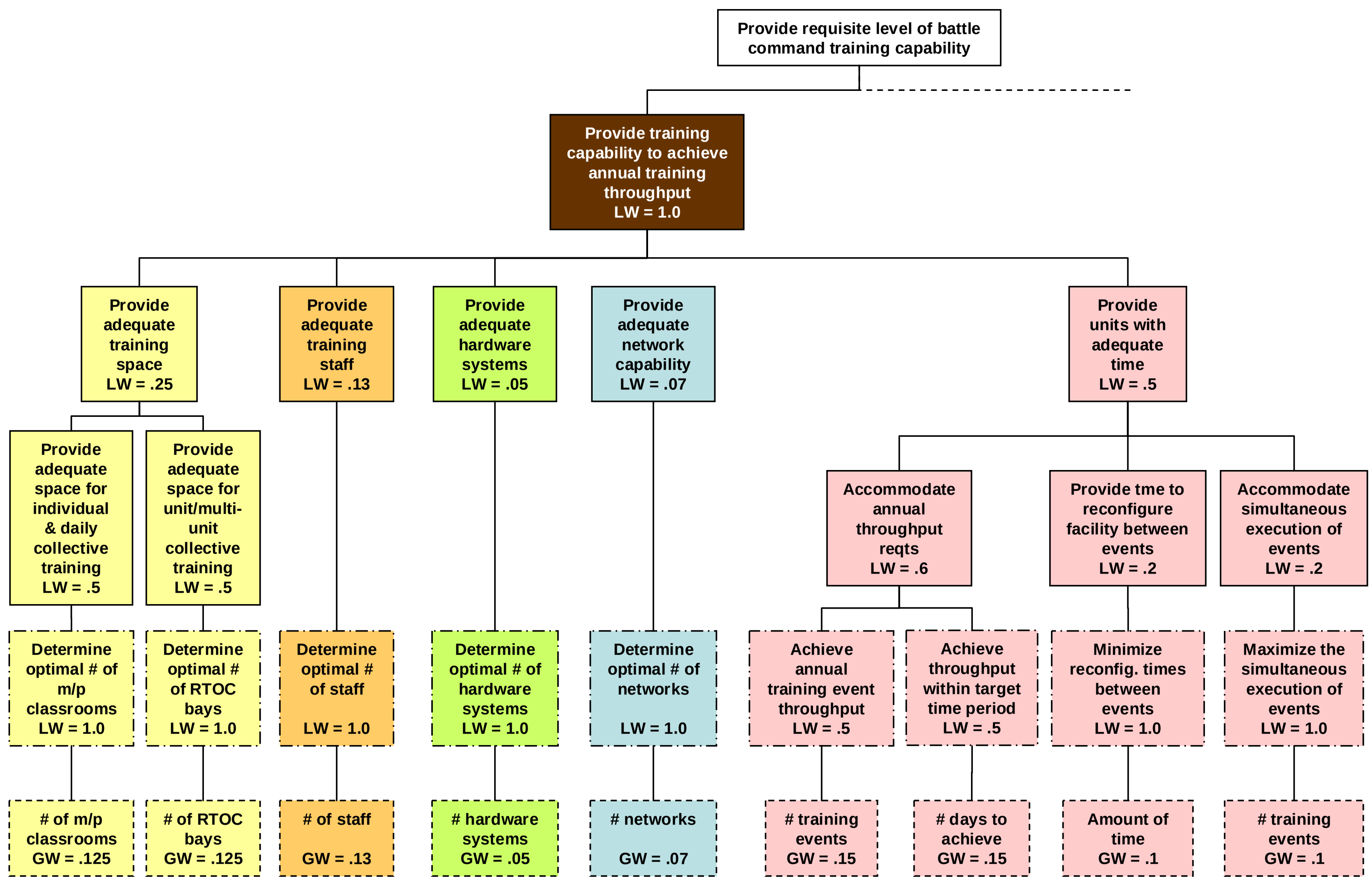
Functional Hierarchy

(2 of 2)

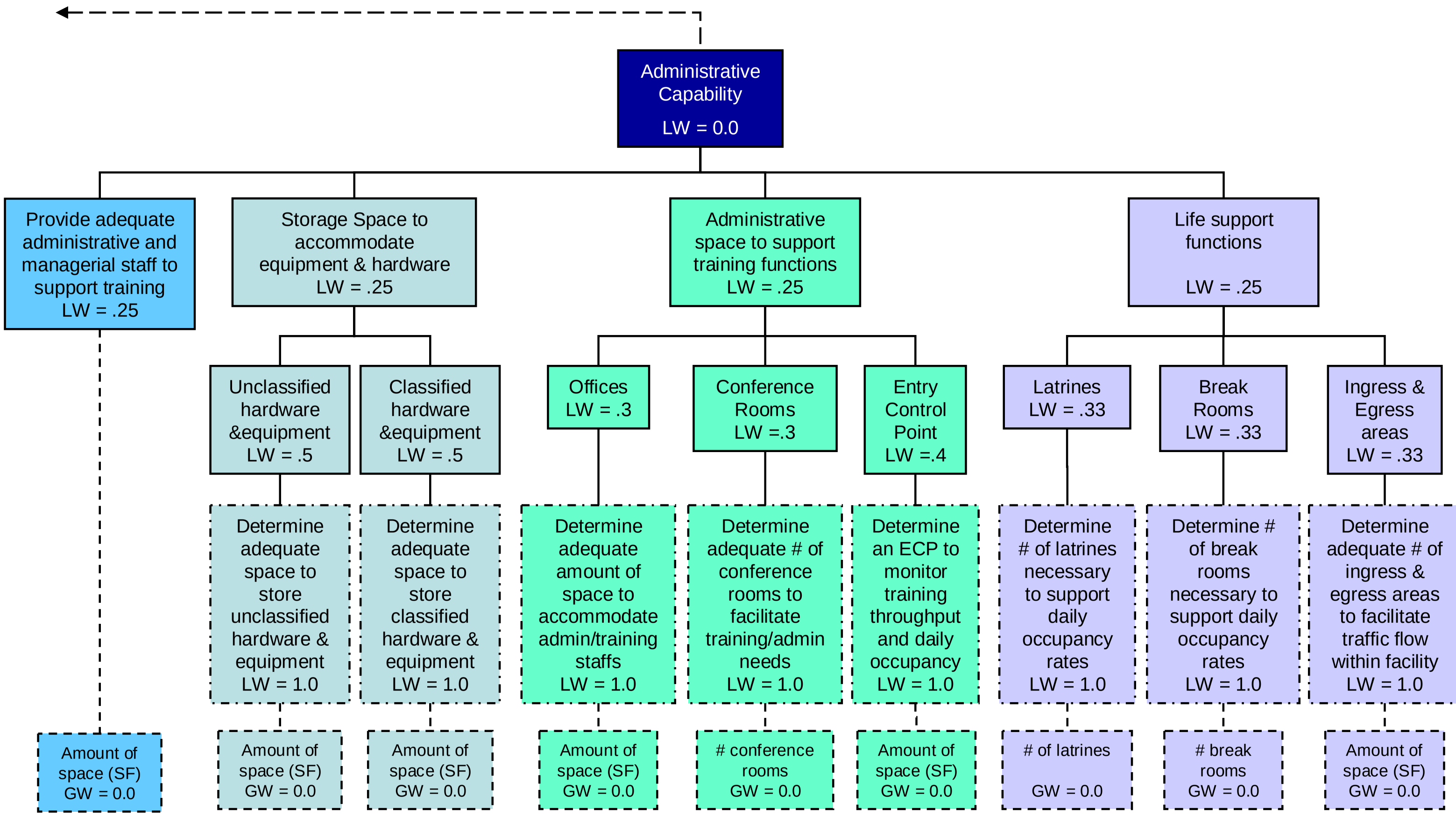


Value Hierarchy

(1 of 2)



Value Hierarchy
(2 of 2)



Appendix E: Individual Training Event Matrices

Required Training Time per Individual Training Entity

	Training Category	1 AFATDS	2 AFATDS 13F	3 AFATDS 13P	4 AFATDS 13D	5 AMPDCS	6 ASAS-L	7 BCS3	8 MCS-L	9 FBCB2	10 FBCB2 ULM	11 BFT	12 BFT ULM	13 DTSS	14 TAIS	15 GCSS-A	16 C2PC	17 CPOF	18 JADOCS
HOURS	Operator	80	40	24	32	57	80	40	40	40	40	36	36	32	40	40	24	8	40
	Integrator	32	0	0	0	32	32	0	32	32	0	0	0	32	0	0	0	0	0
	Leader	32	0	0	0	40	40	16	40	40	0	0	0	32	0	0	5	8	0
	Sustainment	32	0	0	0	26	32	32	24	40	0	0	0	24	22	22	22	0	0

DAYS	Training Category	AFATDS	AFATDS 13F	AFATDS 13P	AFATDS 13D	AMPDCS	ASAS-L	BCS3	MCS-L	FBCB2	FBCB2 ULM	BFT	BFT ULM	DTSS	TAIS	GCSS-A	C2PC	CPOF	JADOCS
Day Length Factor	Operator	10	5	3	4	8	10	5	5	5	5	5	5	4	5	5	3	1	5
8	BS Integrator	4	0	0	0	4	4	0	4	4	0	0	0	4	0	0	0	0	0
	DM/Leader	4	0	0	0	5	5	2	5	5	0	0	0	4	0	0	1	1	0
	Sustainment	4	0	0	0	4	4	4	3	5	0	0	0	3	3	3	3	0	0

		Training Category	1 AFATDS	2 AFATDS 13F	3 AFATDS 13P	4 AFATDS 13D	5 AMPDCS	6 ASAS-L	7 BCS3	8 MCS-L	9 FBCB2	10 FBCB2 ULM	11 BFT	12 BFT ULM	13 DTSS	14 TAIS	15 GCSS-A	16 C2PC	17 CPOF	18 JADOCS
LARGE BCTC	Annual Soldier Thru-put	Operator Training	142	110	17	21	8	117	132	355	1686	73	1407	51	11	8	36	0	157	0
		Integrator Training	78	61	9	11	5	64	73	195	927	0	0	0	6	0	0	0	0	0
		Leader Training	21	17	2	3	1	18	20	54	255	0	0	0	2	0	0	0	24	0
		Sustainment Training	283	220	33	41	17	234	264	710	3372	0	0	0	22	17	72	0	0	0
	Reqd # of Classes	Operator Training	8	6	1	2	1	6	7	18	85	4	71	3	1	1	2	0	8	0
		Integrator Training	4	4	1	1	1	4	4	10	47	0	0	0	1	0	0	0	0	0
		Leader Training	2	1	1	1	1	1	1	3	13	0	0	0	1	0	0	0	2	0
		Sustainment Training	15	11	2	3	1	12	14	36	169	0	0	0	2	1	4	0	0	0
MEDIUM BCTC	Annual Soldier Thru-put	Operator Training	125	102	17	25	8	117	50	338	1991	71	0	0	11	8	32	0	157	0
		Integrator Training	69	56	9	14	5	64	27	186	1095	0	0	0	6	0	0	0	0	0
		Leader Training	19	15	2	4	1	18	7	51	301	0	0	0	2	0	0	0	24	0
		Sustainment Training	250	204	33	50	17	234	99	677	3982	0	0	0	22	17	63	0	0	0
	Reqd # of Classes	Operator Training	7	6	1	2	1	6	3	17	100	4	0	0	1	1	2	0	8	0
		Integrator Training	4	3	1	1	1	4	2	10	55	0	0	0	1	0	0	0	0	0
		Leader Training	1	1	1	1	1	1	1	3	16	0	0	0	1	0	0	0	2	0
		Sustainment Training	13	11	2	3	1	12	5	34	200	0	0	0	2	1	4	0	0	0
SMALL BCTC	Annual Soldier Thru-put	Operator Training	23	19	0	8	1	22	0	55	540	17	0	0	1	1	4	0	33	0
		Integrator Training	13	11	0	5	1	12	0	30	297	0	0	0	1	0	0	0	0	0
		Leader Training	4	3	0	1	0	3	0	8	82	0	0	0	0	0	0	0	5	0
		Sustainment Training	47	39	0	17	3	44	0	110	1081	0	0	0	3	3	8	0	0	0
	Reqd # of Classes	Operator Training	2	1	0	1	1	2	0	3	28	1	0	0	1	1	1	0	2	0
		Integrator Training	1	1	0	1	1	1	0	2	15	0	0	0	1	0	0	0	0	0
		Leader Training	1	1	0	1	1	1	0	1	5	0	0	0	1	0	0	0	1	0
		Sustainment Training	3	2	0	1	1	3	0	6	55	0	0	0	1	1	1	0	0	0

Daily Individual TngEntity Occurrences per BCTC Size

		Standard #'s Based on Metrics			Adjusted #'s for ARFORGEN		
		Large	Medium	Small	Large	Medium	Small
1	e_DI_AFATDS_OPTR	8	7	2	6	5	2
2	e_DI_AFATDS_INT	4	4	1	3	3	1
3	e_DI_AFATDS_LDR	2	1	1	2	1	1
4	e_DI_AFATDS_SUS	15	13	3	10	9	2
5	e_DI_AFATDS 13F_OPTR	6	6	1	0	0	0
6	e_DI_AFATDS 13P_OPTR	1	1	0	0	0	0
7	e_DI_AFATDS 13D_OPTR	2	2	1	0	0	0
8	e_DI_AMPDCS_OPTR	1	1	1	1	1	1
9	e_DI_AMPDCS_INT	1	1	1	1	1	1
10	e_DI_AMPDCS_LDR	1	1	1	1	1	1
11	e_DI_AMPDCS_SUS	1	1	1	1	1	1
12	e_DI_ASAS-L_OPTR	6	6	2	4	4	2
13	e_DI_ASAS-L_INT	4	4	1	3	3	1
14	e_DI_ASAS-L_LDR	1	1	1	1	1	1
15	e_DI_ASAS-L_SUS	12	12	3	8	8	2
16	e_DI_BCS3_OPTR	7	3	0	5	2	0
17	e_DI_BCS3_LDR	1	1	0	1	1	0
18	e_DI_BCS3_SUS	14	5	0	10	4	0
19	e_DI_MCS-L_OPTR	18	17	3	12	12	2
20	e_DI_MCS-L_INT	10	10	2	7	7	2
21	e_DI_MCS-L_LDR	3	3	1	2	2	1
22	e_DI_MCS-L_SUS	36	34	6	24	23	4
23	e_DI_FBCB2_OPTR	85	100	28	57	67	19
24	e_DI_FBCB2_INT	47	55	15	32	37	10
25	e_DI_FBCB2_LDR	13	16	5	9	11	4
26	e_DI_FBCB2_SUS	169	200	55	113	134	37
27	e_DI_FBCB2 ULM_OPTR	4	4	1	3	3	1
28	e_DI_BFT_OPTR	71	0	0	48	0	0
29	e_DI_BFT ULM_OPTR	3	0	0	2	0	0
30	e_DI_DTSS_OPTR	1	1	1	1	1	1
31	e_DI_DTSS_INT	1	1	1	1	1	1
32	e_DI_DTSS_LDR	1	1	1	1	1	1
33	e_DI_DTSS_SUS	2	2	1	2	2	1
34	e_DI_TAIS_OPTR	1	1	1	1	1	1
35	e_DI_TAIS_SUS	1	1	1	1	1	1
36	e_DI_GCSS-A_OPTR	2	2	1	2	2	1
37	e_DI_GCSS-A_SUS	4	4	1	3	3	1
38	e_DI_C2PC_OPTR	1	1	1	1	1	1
39	e_DI_C2PC_LDR	1	1	1	1	1	1
40	e_DI_C2PC_SUS	1	1	1	1	1	1
41	e_DI_CPOF_OPTR	8	8	2	6	6	2
42	e_DI_CPOF_LDR	2	2	1	2	2	1
43	e_DI_JADOCS_OPTR	1	1	1	1	1	1
	TOTALS	573	536	151	390	365	111

The numbers in the matrices above stem directly from the matrices on the previous page. In short, used the ADTS metrics to compute the annual training load in hours, which we then coverted into days in order to establish the duration attributes for each event. Additionally, we used the annual soldier throughput for each event to determine the number of times each event would have to occur throughout the year based on a max class-size of 20 soldiers for each type of training event (e.g., 41-60 soldiers requiring FBCB2 training per year translates to three training events per year).

Appendix F: Collective Training Event Matrices

Collective Training Event Matrices (Based on ARFORGEN Training Matrices, (DA, 2005a)

	Unit Types	Corps	Division	HBCT	IBCT	SBCT	Fires BDE	MEB	Eng BDE	AVN BDE	MP BDE	ADA Bde	Sust BDE
LARGE BCTC	Number	1	1	3	0	0	1	1	1	1	1	0	1
	Adjusted #	1	1	2	0	0	0.67	0.67	0.67	0.67	0.67	0	0.67
	# Bns	0	0	6	0	0	2	2	2	1.33	1.33	0	2
	# Cos	0	0	24	0	0	8	6	6	4	4	0	6
	# Plts	0	0	72	0	0	24	18	18	12	12	0	18

	Unit Types	Corps	Division	HBCT	IBCT	SBCT	Fires BDE	MEB	Eng BDE	AVN BDE	MP BDE	ADA Bde	Sust BDE
MEDIUM BCTC	Number	0	1	0	3	0	0	1	0	1	0	0	1
	Adjusted #	0	1	0	2	0	0	0.67	0	0.67	0	0	0.67
	# Bns	0	0	0	6	0	0	2	0	1.33	0	0	2
	# Cos	0	0	0	24	0	0	6	0	4	0	0	6
	# Plts	0	0	0	72	0	0	18	0	12	0	0	18

	Unit Types	Corps	Division	HBCT	IBCT	SBCT	Fires BDE	MEB	Eng BDE	AVN BDE	MP BDE	ADA Bde	Sust BDE
SMALL BCTC	Number	0	0	0	0	1	0	0	0	0	0	0	0
	Adjusted #	0	0	0	0	0.67	0	0	0	0.00	0	0	0.00
	# Bns	0	0	0	0	2	0	0	0	0	0	0	0
	# Cos	0	0	0	0	8	0	0	0	0	0	0	0
	# Plts	0	0	0	0	24	0	0	0	0	0	0	0

ARFORGEN TRAINING EVENTS MATRIX (LARGEST ANNUAL CASE)

Echelon	Collective Tng Type	Corps	Division	HBCT	IBCT	SBCT	Fires BDE	MEB	Eng BDE	AVN BDE	MP Bde	ADA Bde	Sust BDE
Platoon	PLT STX			2	2	2							
Company	CO STX			2	2	2							
Battalion	Battle Staff Tng			4	4	4	1		2		2		
Battalion	CPX			2	2	2	1		2		2		1
Brigade	Battle Staff Tng			4	4	4	2	2	2		2		
Brigade	CPX			2	2	2		2	2		2		1
Corps/Div	CPX	4	4										
Corps/Div	WFX	1	1										

		Large	Medium	Small
Platoon	PLT STX	144	144	48
Company	CO STX	48	48	16
Battalion	Battle Staff Tng	33	24	8
Battalion	BN CPX	23	14	4
Brigade	Battle Staff Tng	14	10	3
Brigade	Bde CPX	9	6	2
Division (Uex)	Div CPX	4	0	0
Division (Uex)	Div WFX	1	0	0
Corps (Uey)	Corps CPX	4	4	0
Corps (Uey)	Corps WFX	1	1	0
Joint	JTX	1	0	0

Appendix G: Consolidated Modeling Assumptions

Category	Assumption	Explanation
Entity throughput	• Due to ARFORGEN cycles, BCTC capability must support annual training requirements for 2/3 of installation units.	ARFORGEN cycles are based on the notion of modular brigades that will deploy as individual entities to be task organized to sister divisions. Moreover, this model is founded in the reality that the Army is operating (indefinitely) on a continuous operational deployment cycle. Thus, at any one time, approximately 1/3 of the BCTC-using units will be deployed.
	• The arrival of certain major events, such as a JTX or WFX, would, by default, included higher/lower echelons within that event, which would count towards throughput requirements for those included echelons.	This makes sense insofar as a WFX involves multiple echelons down to brigade level. As such, a Corps WFX, for example, would include a Div WFX and five Brigade CPXs. For brigade CPXs, this was handled differently. On some occasions, brigade CPs may train alone as a staff, while on others, they may incorporate some of their "children" battalion CPs.
	• JTX, Corps, and Division-level exercises will bypass the AAR location	We account for a "recovery phase" for all events at these levels. In the simulation, however, the entity actually remains at the RTOC Bay location to reflect the continued consumption of space and staff resources. As such, it is reasonable to assume that any AAR activities would actually occur during this time.
	• There are 3 platoons per company, 4 companies per battalion, and 3 battalions per brigade for the purposes of establishing annual training requirements	We based this assumption on standard organizational methods for combat arms and combat support arms units.
	• Training event durations for battalion-level events and above follow normal distributions with a mean and variance determined from field data.	These events fluctuate for various reasons, including how long it takes certain units to achieve training objectives, how long it takes to prepare for/recover from an event, etc. As such, based on data collected at various field locations, as well as on input from subject matter experts in the BCTC Working Group, we determined that the most appropriate distribution to apply to these aspects of variability was the Normal distribution.
Simultaneity between events	• Given the availability of space and resources when a training event arrives to the system, all events can occur simultaneously except during the execution phase of major events involving a Division HQ or higher.	During any division-level or higher CPX, WFX, or JTX, the execution phase becomes an all-resource consuming event for the BCTC. It is during this phase that these events occupy the entire facility and require the involvement of the entire training staff. Thus, during these times, no other events can occur. However, at any other time, all other events can occur.

Category	Assumption	Explanation
Time	• Modeling Steady State conditions	We assumed that, for the purposes of our simulation, we did not need to account for a warm-up period. This is because in reality, there are no hard start and end points for annual training, as far as gated training strategies are concerned. Rather, training throughout the year and between years is often viewed as a continuous process instead of a series of smaller year-long processes. However, there are still annual requirements that units must achieve.
	• Training year = 235 days.	We removed weekends and standard training holidays. While this is perceived, and in some ways treated as an upper constraint, in reality, it is not, as there will invariably be weekends on which training occurs throughout the year
	• Average training day = 16 hours	To compute this average, we first determined that, while most of the training days throughout the year would be 8-hour days, the execution phases of larger collective events (CPXs, WFXs, and JTXs) would consist of 24-hour continuous operations. Thus, we obtained an average training day of approximately 16 hours (after rounding up). See Appendix ___ for the complete computation.
Space Usage	• Multipurpose rooms (including classrooms) could accommodate any type of daily individual or daily collective training events.	Classrooms in current facilities are dedicated to specific individual training functions (i.e., FBCB2 classrooms are set up and used for FBCB2 training only). Thus, if a facility has only four classrooms dedicated to this type of training, then that is the most that can occur at any one time. Although the primary reason for this concerns hardware compatibility issues, we nevertheless felt this contradicted any notion of a reconfigurable training environment. Since these compatibility issues are currently being addressed, we assumed that they would be in place for future facilities. Thus, any room can accommodate any type of training event.
	• Multi-unit collective events that involve more units than the facility can physically accommodate will replicate command posts that would actually be wired into the facility from field locations or other facilities, such as Battle Simulation Centers. These count towards annual throughput.	This is an extension of the assumption two categories above. In short, major events, such as WFXs involve many units and personnel. No facility can accommodate them all. As such, several of the units will establish their CPs in the field and be fed into the constructive portion of the exercise. These unit events then count towards annual throughput.

Category	Assumption	Explanation
Resources	• Staff requirements for scenario development and planning 1-6 months prior to major training exercises would not impact day-to-day throughput.	Currently, these types of things are done in conjunction with day-to-day training activities. As it stands, many of these exercise scenarios are becoming off-the-shelf products maintained in training repositories. Thus, except for infrequent occasions, these development phases should not tax the training capability.
	• The only staff functions we need to include in the model are individual training (IT), collective training (CT), simulation/stimulation (Sim/Stim), technical support (TechSpt), and training support (TngSpt). • We can omit the administrative staff from consideration in the model	The administrative staff is a peripheral function associated with the day-to-day management of the facility and the training conducted therein. It does not correspond to the core training capability. Consequently, we assumed that the omission of this peripheral function would have no significant impact on the training capability or our ability to accurately imitate it.
	• Multi-unit events will utilize a proportion of the aggregated staff requirements.	This implies that there would be staff overlap between units participating in the event.
	• We do not need to replicate hardware requirements, as this is dictated, in large part, by the soldier and unit throughput.	Space and staff will really determine what throughput the facility can accommodate. We consider hardware platforms a peripheral requirement to support training.

Appendix H: Flow Diagrams

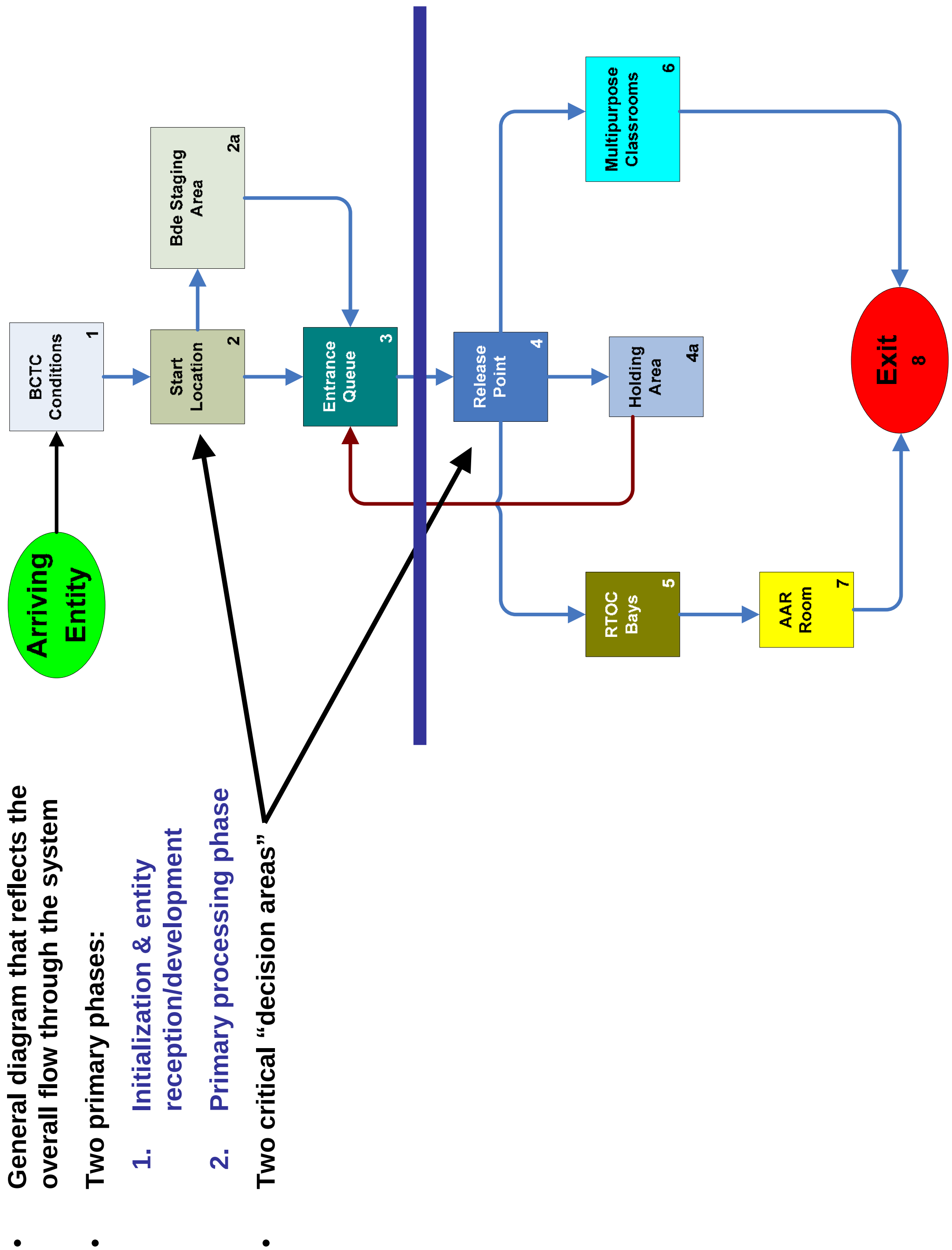


Figure H. 1. General flow diagram depicting the entity flow through the BCTC system. We used this diagram in the development of coding sequences and model verification. The two decision areas are depicted in Figures H.2 and H.3 respectively.

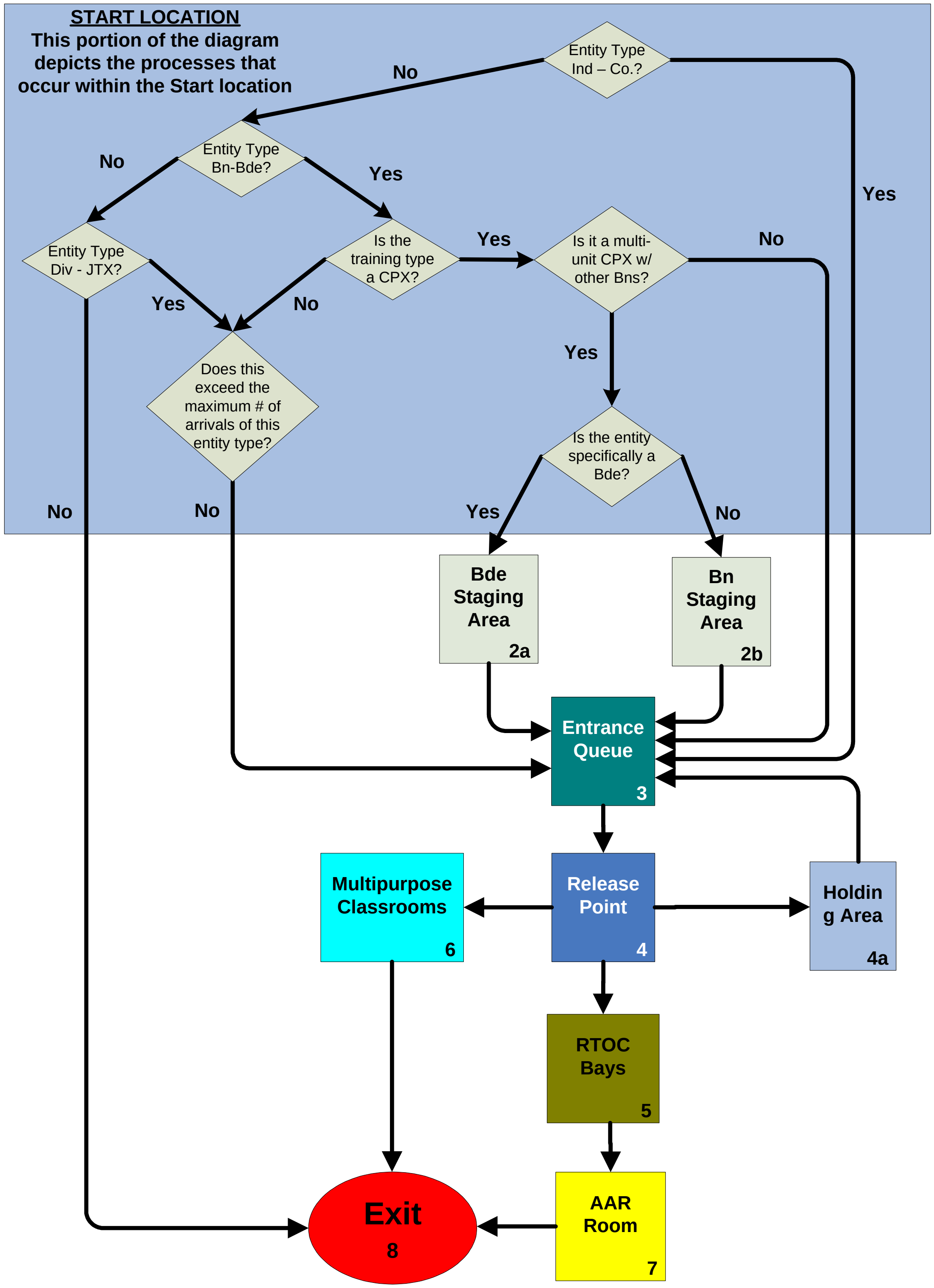


Figure H. 2. Diagram revealing the details of the decision process that occurs at the Start Location and how entities get processed to subsequent locations. The details for the Release Point location are covered in Figure H.3 on the next page.

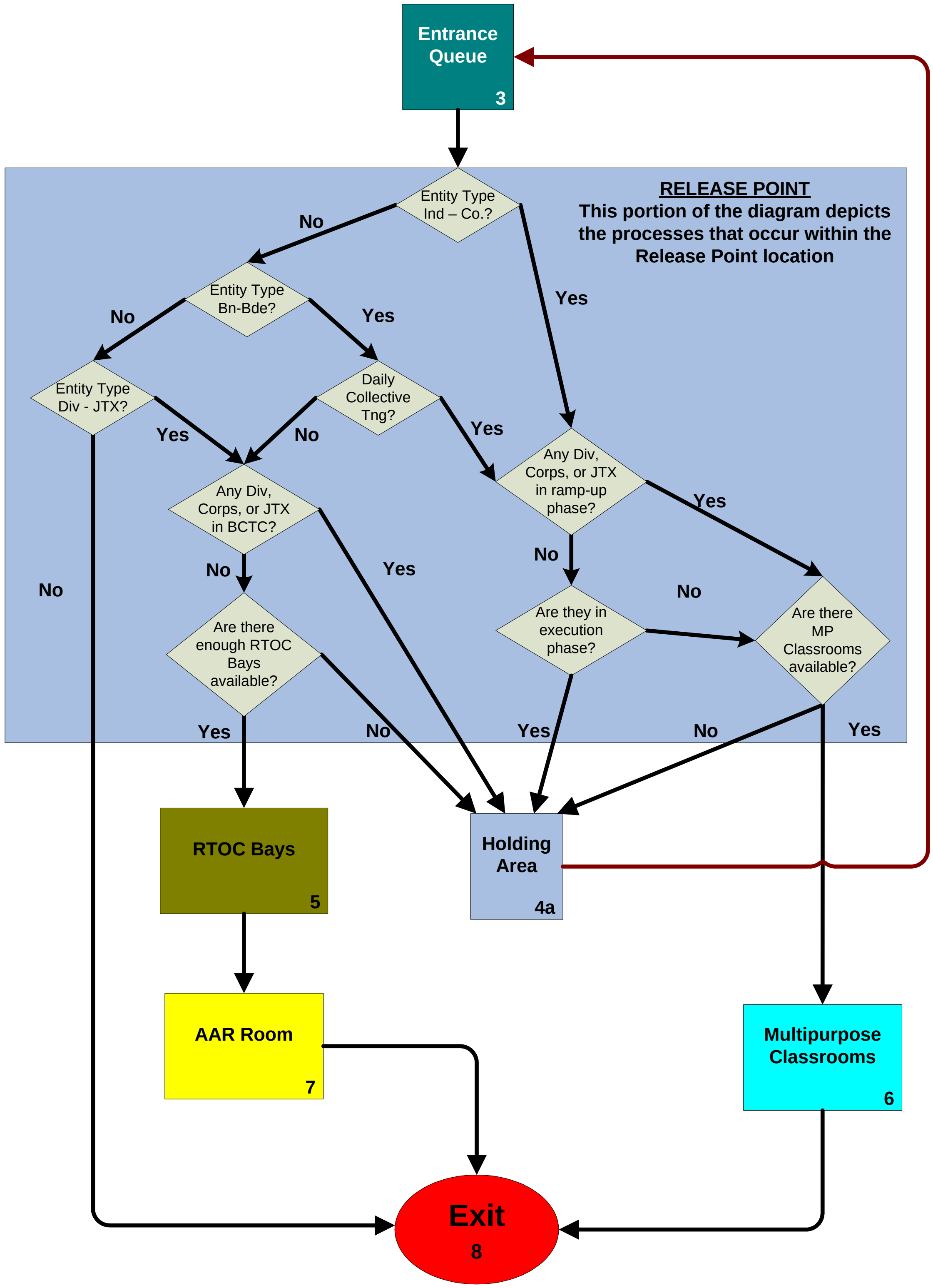


Figure H. 3. Diagram revealing the details of the decision processes occuring at the Release Point location.

Appendix I: Model Framework

The following matrices reflect the framework we used to begin our model development. We essentially built each of the components required in ProModel in MS Excel to facilitate "cut/copy and paste" operations. These matrices also served as canvases to which we could return and update as our model developed, leaving us with a record that essentially tracked the development process. The matrices included are:

1) Locations
2) Entities
3) Arrivals
4) Attributes
5) Variables
6) Resources
7) Macros
8) User Distributions
9) Interfaces
10) Path Networks

Model Framework: Locations

Name	Quantity	Cap	Units	Stats	Rules	Cost
loc_Start	1	1	1	Time Series	Oldest	
loc_Bde_Staging_Area	1	INFINITE	1	Time Series	Oldest, FIFO	
loc_Entrance_Queue	1	INFINITE	1	Time Series	Oldest	
loc_Release_Point	1	1	1	Time Series	Oldest	
loc_Holding_Area	1	INFINITE	1	Time Series	Oldest	
loc_RTOC_Bays	depends on BCTC size and stated macro range	BCTC size dependent	1	Time Series	Oldest	
loc_MPCR	depends on BCTC size and stated macro range	BCTC size dependent	1	Time Series	Oldest	
loc_MPAAR	depends on BCTC size and stated macro range	BCTC size dependent	1	Time Series	Oldest	
loc_Exit	1	1	1	Time Series	Oldest	

Model Framework: Entities

Ref #	Name	Entity Type (attribute)	Entity Training Type (attribute)	Quantity	Duration of Each (Days)	Speed (fpm)	Stats	Simultaneity Constraints (cannot occur with…)
1	e_DI_AFATDS_OPTR	9	5	9	12	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
2	e_DI_AFATDS_INT	9	5	5	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
3	e_DI_AFATDS_LDR	9	5	2	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
4	e_DI_AFATDS_SUS	9	5	18	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
8	e_DI_AMPDCS_OPTR	9	5	1	9	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
9	e_DI_AMPDCS_INT	9	5	1	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
10	e_DI_AMPDCS_LDR	9	5	1	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
11	e_DI_AMPDCS_SUS	9	5	1	4	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
12	e_DI_ASAS-L_OPTR	9	5	7	12	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
13	e_DI_ASAS-L_INT	9	5	4	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
14	e_DI_ASAS-L_LDR	9	5	2	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
15	e_DI_ASAS-L_SUS	9	5	14	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
16	e_DI_BCS3_OPTR	9	5	8	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
17	e_DI_BCS3_LDR	9	5	2	3	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
18	e_DI_BCS3_SUS	9	5	16	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
19	e_DI_MCS-L_OPTR	9	5	21	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
20	e_DI_MCS-L_INT	9	5	12	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
21	e_DI_MCS-L_LDR	9	5	4	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
22	e_DI_MCS-L_SUS	9	5	42	4	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
23	e_DI_FBCB2_OPTR	9	5	107	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
24	e_DI_FBCB2_INT	9	5	59	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
25	e_DI_FBCB2_LDR	9	5	17	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
26	e_DI_FBCB2_SUS	9	5	213	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
27	e_DI_FBCB2_ULM_OPTR	9	5	5	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
28	e_DI_BFT_OPTR	9	5	94	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
29	e_DI_BFT_ULM_OPTR	9	5	4	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
30	e_DI_DTSS_OPTR	9	5	1	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
31	e_DI_DTSS_INT	9	5	1	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
32	e_DI_DTSS_LDR	9	5	1	5	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
33	e_DI_DTSS_SUS	9	5	2	4	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
34	e_DI_TAIS_OPTR	9	5	1	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
35	e_DI_TAIS_SUS	9	5	1	4	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
36	e_DI_GCSS-A_OPTR	9	5	3	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
37	e_DI_GCSS-A_SUS	9	5	5	4	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
38	e_DI_C2PC_OPTR	9	5	0	4	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
39	e_DI_C2PC_LDR	9	5	0	4	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
40	e_DI_C2PC_SUS	9	5	0	4	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
41	e_DI_CPOF_OPTR	9	5	10	2	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
42	e_DI_CPOF_LDR	9	5	2	2	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
43	e_DI_JADOCS_OPTR	9	5	0	6	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
44	e_DC_Platoon	6	4	some normally distributed #	N(1, .5)	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
45	e_DC_Company	5	4	some normally distributed #	N(1, .5)	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
46	e_DC_Bn	4	4	4	N(4, 1)	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
47	e_DC_Bde	3	4	4	N(4, 1)	150	Time Series	50 w/ p=.3, 51 w/ p=.4, 52-54 w/ p=1
48	e_Bn_CPX	4	3		N(10, 4)	150	Time Series	50-54
49	e_Bde_CPX	3	3		N(12,4)	150	Time Series	50-54
50	e_Div_CPX	2	3		N(21,7)	150	Time Series	
51	e_Corps_CPX	1	3		N(21,7)	150	Time Series	
52	e_Div_WFX	2	2		N(42, 7)	150	Time Series	
53	e_Corps_WFX	1	2		N(42, 7)	150	Time Series	
54	e_JTX		1		N(30,9)	150	Time Series	

Model Framework: Arrivals

Entity	Location	Qty Each	First	Time	Occurences	Frequency
e_DI_AFATDS_OPTR	loc_Start	1	0		arr_DI_events[1, v_BCTC_size]	N((235/arr_DI_events[1, v_BCTC_size]), (235/arr_DI_events[1, v_BCTC_size])/10)
e_DI_AFATDS_INT	loc_Start	1	0		arr_DI_events[2, v_BCTC_size]	N((235/arr_DI_events[2, v_BCTC_size]), (235/arr_DI_events[2, v_BCTC_size])/10)
e_DI_AFATDS_LDR	loc_Start	1	0		arr_DI_events[3, v_BCTC_size]	N((235/arr_DI_events[3, v_BCTC_size]), (235/arr_DI_events[3, v_BCTC_size])/10)
e_DI_AFATDS_SUS	loc_Start	1	0		arr_DI_events[4, v_BCTC_size]	N((235/arr_DI_events[4, v_BCTC_size]), (235/arr_DI_events[4, v_BCTC_size])/10)
e_DI_AMPDCS_OPTR	loc_Start	1	0		arr_DI_events[8, v_BCTC_size]	N((235/arr_DI_events[8, v_BCTC_size]), (235/arr_DI_events[8, v_BCTC_size])/10)
e_DI_AMPDCS_INT	loc_Start	1	0		arr_DI_events[9, v_BCTC_size]	N((235/arr_DI_events[9, v_BCTC_size]), (235/arr_DI_events[9, v_BCTC_size])/10)
e_DI_AMPDCS_LDR	loc_Start	1	0		arr_DI_events[10, v_BCTC_size]	N((235/arr_DI_events[10, v_BCTC_size]), (235/arr_DI_events[10, v_BCTC_size])/10)
e_DI_AMPDCS_SUS	loc_Start	1	0		arr_DI_events[11, v_BCTC_size]	N((235/arr_DI_events[11, v_BCTC_size]), (235/arr_DI_events[11, v_BCTC_size])/10)
e_DI_ASAS-L_OPTR	loc_Start	1	0		arr_DI_events[12, v_BCTC_size]	N((235/arr_DI_events[12, v_BCTC_size]), (235/arr_DI_events[12, v_BCTC_size])/10)
e_DI_ASAS-L_INT	loc_Start	1	0		arr_DI_events[13, v_BCTC_size]	N((235/arr_DI_events[13, v_BCTC_size]), (235/arr_DI_events[13, v_BCTC_size])/10)
e_DI_ASAS-L_LDR	loc_Start	1	0		arr_DI_events[14, v_BCTC_size]	N((235/arr_DI_events[14, v_BCTC_size]), (235/arr_DI_events[14, v_BCTC_size])/10)
e_DI_ASAS-L_SUS	loc_Start	1	0		arr_DI_events[15, v_BCTC_size]	N((235/arr_DI_events[15, v_BCTC_size]), (235/arr_DI_events[15, v_BCTC_size])/10)
e_DI_BCS3_OPTR	loc_Start	1	0		arr_DI_events[16, v_BCTC_size]	N((235/arr_DI_events[16, v_BCTC_size]), (235/arr_DI_events[16, v_BCTC_size])/10)
e_DI_BCS3_LDR	loc_Start	1	0		arr_DI_events[17, v_BCTC_size]	N((235/arr_DI_events[17, v_BCTC_size]), (235/arr_DI_events[17, v_BCTC_size])/10)
e_DI_BCS3_SUS	loc_Start	1	0		arr_DI_events[18, v_BCTC_size]	N((235/arr_DI_events[18, v_BCTC_size]), (235/arr_DI_events[18, v_BCTC_size])/10)
e_DI_MCS-L_OPTR	loc_Start	1	0		arr_DI_events[19, v_BCTC_size]	N((235/arr_DI_events[19, v_BCTC_size]), (235/arr_DI_events[19, v_BCTC_size])/10)
e_DI_MCS-L_INT	loc_Start	1	0		arr_DI_events[20, v_BCTC_size]	N((235/arr_DI_events[20, v_BCTC_size]), (235/arr_DI_events[20, v_BCTC_size])/10)
e_DI_MCS-L_LDR	loc_Start	1	0		arr_DI_events[21, v_BCTC_size]	N((235/arr_DI_events[21, v_BCTC_size]), (235/arr_DI_events[21, v_BCTC_size])/10)
e_DI_MCS-L_SUS	loc_Start	1	0		arr_DI_events[22, v_BCTC_size]	N((235/arr_DI_events[22, v_BCTC_size]), (235/arr_DI_events[22, v_BCTC_size])/10)
e_DI_FBCB2_OPTR	loc_Start	1	0		arr_DI_events[23, v_BCTC_size]	N((235/arr_DI_events[23, v_BCTC_size]), (235/arr_DI_events[23, v_BCTC_size])/10)
e_DI_FBCB2_INT	loc_Start	1	0		arr_DI_events[24, v_BCTC_size]	N((235/arr_DI_events[24, v_BCTC_size]), (235/arr_DI_events[24, v_BCTC_size])/10)
e_DI_FBCB2_LDR	loc_Start	1	0		arr_DI_events[25, v_BCTC_size]	N((235/arr_DI_events[25, v_BCTC_size]), (235/arr_DI_events[25, v_BCTC_size])/10)
e_DI_FBCB2_SUS	loc_Start	1	0		arr_DI_events[26, v_BCTC_size]	N((235/arr_DI_events[26, v_BCTC_size]), (235/arr_DI_events[26, v_BCTC_size])/10)
e_DI_FBCB2_ULM_OPTR	loc_Start	1	0		arr_DI_events[27, v_BCTC_size]	N((235/arr_DI_events[27, v_BCTC_size]), (235/arr_DI_events[27, v_BCTC_size])/10)
e_DI_BFT_OPTR	loc_Start	1	0		arr_DI_events[28, v_BCTC_size]	N((235/arr_DI_events[28, v_BCTC_size]), (235/arr_DI_events[28, v_BCTC_size])/10)
e_DI_BFT_ULM_OPTR	loc_Start	1	0		arr_DI_events[29, v_BCTC_size]	N((235/arr_DI_events[29, v_BCTC_size]), (235/arr_DI_events[29, v_BCTC_size])/10)
e_DI_DTSS_OPTR	loc_Start	1	0		arr_DI_events[30, v_BCTC_size]	N((235/arr_DI_events[30, v_BCTC_size]), (235/arr_DI_events[30, v_BCTC_size])/10)
e_DI_DTSS_INT	loc_Start	1	0		arr_DI_events[31, v_BCTC_size]	N((235/arr_DI_events[31, v_BCTC_size]), (235/arr_DI_events[31, v_BCTC_size])/10)
e_DI_DTSS_LDR	loc_Start	1	0		arr_DI_events[32, v_BCTC_size]	N((235/arr_DI_events[32, v_BCTC_size]), (235/arr_DI_events[32, v_BCTC_size])/10)
e_DI_DTSS_SUS	loc_Start	1	0		arr_DI_events[33, v_BCTC_size]	N((235/arr_DI_events[33, v_BCTC_size]), (235/arr_DI_events[33, v_BCTC_size])/10)
e_DI_TAIS_OPTR	loc_Start	1	0		arr_DI_events[34, v_BCTC_size]	N((235/arr_DI_events[34, v_BCTC_size]), (235/arr_DI_events[34, v_BCTC_size])/10)
e_DI_TAIS_SUS	loc_Start	1	0		arr_DI_events[35, v_BCTC_size]	N((235/arr_DI_events[35, v_BCTC_size]), (235/arr_DI_events[35, v_BCTC_size])/10)
e_DI_GCSS-A_OPTR	loc_Start	1	0		arr_DI_events[36, v_BCTC_size]	N((235/arr_DI_events[36, v_BCTC_size]), (235/arr_DI_events[36, v_BCTC_size])/10)
e_DI_GCSS-A_SUS	loc_Start	1	0		arr_DI_events[37, v_BCTC_size]	N((235/arr_DI_events[37, v_BCTC_size]), (235/arr_DI_events[37, v_BCTC_size])/10)
e_DI_C2PC_OPTR	loc_Start	1	0		arr_DI_events[38, v_BCTC_size]	N((235/arr_DI_events[38, v_BCTC_size]), (235/arr_DI_events[38, v_BCTC_size])/10)
e_DI_C2PC_LDR	loc_Start	1	0		arr_DI_events[39, v_BCTC_size]	N((235/arr_DI_events[39, v_BCTC_size]), (235/arr_DI_events[39, v_BCTC_size])/10)
e_DI_C2PC_SUS	loc_Start	1	0		arr_DI_events[40, v_BCTC_size]	N((235/arr_DI_events[40, v_BCTC_size]), (235/arr_DI_events[40, v_BCTC_size])/10)
e_DI_CPOF_OPTR	loc_Start	1	0		arr_DI_events[41, v_BCTC_size]	N((235/arr_DI_events[41, v_BCTC_size]), (235/arr_DI_events[41, v_BCTC_size])/10)
e_DI_CPOF_LDR	loc_Start	1	0		arr_DI_events[42, v_BCTC_size]	N((235/arr_DI_events[42, v_BCTC_size]), (235/arr_DI_events[42, v_BCTC_size])/10)
e_DI_JADOCS_OPTR	loc_Start	1	0		arr_DI_events[43, v_BCTC_size]	N((235/arr_DI_events[43, v_BCTC_size]), (235/arr_DI_events[43, v_BCTC_size])/10)
e_DC_Platoon	loc_Start	1	0		arr_coll_events[1, v_BCTC_size]	N((235/arr_coll_events[1, v_BCTC_size]), (235/arr_coll_events[1, v_BCTC_size])/10)
e_DC_Company	loc_Start	1	0		arr_coll_events[2, v_BCTC_size]	N((235/arr_coll_events[2, v_BCTC_size]), (235/arr_coll_events[2, v_BCTC_size])/10)
e_DC_Bn_BattleStaff	loc_Start	1	0		arr_coll_events[3, v_BCTC_size]	N((235/arr_coll_events[3, v_BCTC_size]), (235/arr_coll_events[3, v_BCTC_size])/10)
e_DC_Bde_BattleStaff	loc_Start	1	0		arr_coll_events[4, v_BCTC_size]	N((235/arr_coll_events[4, v_BCTC_size]), (235/arr_coll_events[4, v_BCTC_size])/10)
e_Bn_CPX	loc_Start	1	0		arr_coll_events[5, v_BCTC_size]	N((235/arr_coll_events[5, v_BCTC_size]), (235/arr_coll_events[5, v_BCTC_size])/10)
e_Bde_CPX	loc_Start	1	0		arr_coll_events[6, v_BCTC_size]	N((235/arr_coll_events[6, v_BCTC_size]), (235/arr_coll_events[6, v_BCTC_size])/10)
e_Div_CPX	loc_Start	1	0		arr_coll_events[7, v_BCTC_size]	N((235/arr_coll_events[7, v_BCTC_size]), (235/arr_coll_events[7, v_BCTC_size])/10)
e_Corps_CPX	loc_Start	1	0		arr_coll_events[8, v_BCTC_size]	N((235/arr_coll_events[8, v_BCTC_size]), (235/arr_coll_events[8, v_BCTC_size])/10)
e_Div_Warfighter	loc_Start	1	0		arr_coll_events[9, v_BCTC_size]	N((235/arr_coll_events[9, v_BCTC_size]), (235/arr_coll_events[9, v_BCTC_size])/10)
e_Corps_Warfighter	loc_Start	1	0		arr_coll_events[10, v_BCTC_size]	N((235/arr_coll_events[10, v_BCTC_size]), (235/arr_coll_events[10, v_BCTC_size])/10)
e_Joint_TheaterExercise	loc_Start	1	0		arr_coll_events[11, v_BCTC_size]	N((235/arr_coll_events[11, v_BCTC_size]), (235/arr_coll_events[11, v_BCTC_size])/10)

Model Framework: Path Networks

Name	Type	T/S	From	To	BI	Dist/Time
Net_DI	Passing	Speed & Distance	n_Release_Point	n_MPCR_DI	Bi	0
	Passing	Speed & Distance	n_MPCR_DI	n_Exit_DI	Bi	0
Net_Collective	Passing	Speed & Distance	n_Release_Point	n_RTOC_Bays	Bi	0
	Passing	Speed & Distance	n_RTOC_Bays	n_AAR	Bi	0
	Passing	Speed & Distance	n_AAR	n_Exit_Collective	Bi	0
Net_Resource	Passing	Speed & Distance	n_res_break	n_res_MPCR	Bi	0
	Passing	Speed & Distance	n_res_MPCR	n_res_break	Bi	0
	Passing	Speed & Distance	n_res_AAR	n_res_break	Bi	0

Model Framework: Attributes

	ID	Type	Classification	Notes
1	a_creation_num	Integer	Entity	gives each entity a unique identifier as it goes through the simulation so that it can be tracked
2	a_entity_ref_number	Integer	Entity	Reference/ID number for the entity type
3	a_entity_type	Integer	Entity	The type of entity (1 - Joint, 2 - Corps, 3 - Div, 4 - Bde, 5 - Bn, 6 - Co, 7 - Plt, 8 - Ind)
4	a_entity_priority	Real	Entity	Sets the entity's training priority relative to other entities
5	a_entity_tng_type	Real	Entity	What is the type of training (1 - Joint Theater Exercise, 2 - Warfighter, 3 - CPX, 3.5 - bn&bde CPX or multi-bn CPX, 4 - Collective, 5 - Individual, etc.)
6	a_entity_tng_duration	Integer	Entity	For Daily Individual Classroom events, this is an integer that is specified at loc_start: 2 - 2 days, 3 - 3 days, 4 - 4 days, 5 - 5 days, 6 - 6 days, 9 - 9 days, 12 - 12 days For various collective events, this is a random attribute as follows: DC_plt: N(1, 0.5) DC_co: N(1, 0.2) bn_DC: N(4, 0.5) bde_DC (4, 0.5) bn_CPX: N(10, 4) bde_CPX: N(12, 4) div_CPX: N(18, 7) div_WFX: N(42, 7) corps_CPX: N(18, 7) corps_WFX: N(42, 7) JTX: N(42, 7)
7	a_entity_tng_rampup_days	Integer	Entity	Tracks the days in the training ramp-up period for corps, div, and JTX Div CPX: N(10, 2) Corps CPX: N(10, 2) Div WFX: N(28, 2) Corps WFX: N(28, 2) JTX: N(28, 2)
8	a_entity_tng_execution_days	Integer	Entity	Tracks the days in the training execution period for corps, div, and JTX Div CPX: N(5, 1) Corps CPX: N(5, 1) Div WFX: N(12, 2) Corps WFX: N(12, 2) JTX: N(12, 2)
9	a_entity_tng_recovery_days	Integer	Entity	Tracks the days in the training recovery period for corps, div, and JTX Div CPX: N(3, 1) Corps CPX: N(3, 1) Div WFX: N(5, 2) Corps WFX: N(5, 2) JTX: N(5, 2)
10	a_entity_num_tngdays	Integer	Entity	this tracks the number of days in training for each specific entity; this allows us to track the number of training days that have elapsed for a specific entity
11	a_entity_num_tngdays_rem	Integer	Entity	allows us to track the number of training days a particular entity has remaining: = (a_entity_tng_duration - a_entity_num_tngdays_
12	a_entity_start_tng	Integer	Entity	sets the entity's training start time equal to the sim clock time when the entity is allowed to proceed forward from the release point
13	a_entity_tng_level	Integer	Entity	0 - Operator, 1 - Integrator, 2 - Leader, 3 - Sustainment
14	a_entity_tng_phase	Integer	Entity	1 - rampup, 2 - execution, 3 - recovery
15	a_num_bns_w_bde	Integer	Entity	This provides for occasions when a Bde conducts CPX training with one or more of its subordinate Bns under a single training scenario, OR when a Bn conducts CPX training with one or more of its sister Bns under a single training scenario
16	a_entity_RTOC_bays_req	Integer	Entity	attribute specifies how many RTOC bays an entity requires for training Bn: 1 Bde: 2 Div, Corps, JTX: ALL [a_entity_RTOC_bays_reqd = v_num_RTOC_bays
17	a_entity_num_IT_staff_reqd	Integer	Entity	specifies the number of staff required per training event type; dictated by a macro
18	a_entity_num_CT_staff_reqd			
19	a_entity_num_SimStim_staff_reqd			
20	a_entity_num_TechSpt_staff_reqd			
21	a_entity_num_TngSpt_staff_reqd			
22	a_entity_num_networks_reqd	Integer	Entity	specifies the number of networks required per collective training event type; dictated by a macro

Model Framework: Variables

ID	Type	Initial Value	Stats	Status
v_BCTC_size	Integer	0	Time Series	Added
ENTITY VARIABLES				
v_Num_Total_Entities_Start	Integer	0	Time Series	Added
v_Num_JTX_start	Integer	0	Time Series	Added
v_num_corps_start	Integer	0	Time Series	Added
v_Num_CorpsWFX_start	Integer	0	Time Series	Added
v_Num_CorpsCPX_start	Integer	0	Time Series	Added
v_num_div_start	Integer	0	Time Series	Added
v_Num_DivWFX_start	Integer	0	Time Series	Added
v_Num_DivCPX_start	Integer	0	Time Series	Added
v_Num_Bde_Start	Integer	0	Time Series	Added
v_Num_Bn_Start	Integer	0	Time Series	Added
v_Num_Co_Start	Integer	0	Time Series	Added
v_Num_Plt_Start	Integer	0	Time Series	Added
v_Num_DI_Start	Integer	0	Time Series	Added
v_Num_Total_Entities_End	Integer	0	Time Series	Added
v_Num_JTX_End	Integer	0	Time Series	Added
v_num_corps_end	Integer	0	Time Series	Added
v_Num_CorpsWFX_End	Integer	0	Time Series	Added
v_Num_CorpsCPX_End	Integer	0	Time Series	Added
v_num_div_end	Integer	0	Time Series	Added
v_Num_DivWFX_End	Integer	0	Time Series	Added
v_Num_DivCPX_End	Integer	0	Time Series	Added
v_Num_Bdes_End	Integer	0	Time Series	Added
v_Num_Bns_End	Integer	0	Time Series	Added
v_Num_Cos_End	Integer	0	Time Series	Added
v_Num_Plts_End	Integer	0	Time Series	Added
v_Num_DI_End	Integer	0	Time Series	Added
v_Num_Total_Entities_in_BCTC	Integer	0	Time Series	Added
v_Num_JTX_in_BCTC	Integer	0	Time Series	Added
v_Num_Corps_in_BCTC	Integer	0	Time Series	Added
v_Num_CorpsWFX_in_BCTC	Integer	0	Time Series	Added
v_Num_CorpsCPX_in_BCTC	Integer	0	Time Series	Added
v_Num_Div_in_BCTC	Integer	0	Time Series	Added
v_Num_DivWFX_in_BCTC	Integer	0	Time Series	Added
v_Num_DivCPX_in_BCTC	Integer	0	Time Series	Added
v_Num_Bde_in_BCTC	Integer	0	Time Series	Added
v_Num_Bn_in_BCTC	Integer	0	Time Series	Added
v_Num_Co_in_BCTC	Integer	0	Time Series	Added
v_Num_Plt_in_BCTC	Integer	0	Time Series	Added
v_Num_DI_in_BCTC	Integer	0	Time Series	Added
v_Max_Num_Corps_to_Tng	Integer	0	Time Series	Added
v_Max_Num_Divs_to_Tng	Integer	0	Time Series	Added
v_Max_Num_Bdes_to_Tng	Integer	0	Time Series	Added
v_Max_Num_Bns_to_Tng	Integer	0	Time Series	Added
v_Max_Num_Cos_to_Tng	Integer	0	Time Series	Added
v_Max_Num_Plts_to_Tng	Integer	0	Time Series	Added

v_Max_Num_DI_to_Tng	Integer	0	Time Series	Added
v_num_bns_needed_in_BdeSA	Integer	0	Time Series	Added
v_num_bdes_in_BdeSA	Integer	0	Time Series	Added
v_num_entities_in_HA	Integer	0	Time Series	Added
RESOURCE VARIABLES				
v_Num_RTOC_Bays	Integer	0	Time Series	Added
v_Num_MPCR	Integer	0	Time Series	Added
v_num_staff	Integer	0	Time Series	Added
v_num_networks	Integer	0	Time Series	Added
v_num_MPCR_avail	Integer	0	Time Series	Added
v_num_RTOC_bays_avail	Integer	0	Time Series	Added
v_num_staff_avail	Integer	0	Time Series	Added
v_num_networks_avail	Integer	0	Time Series	Added
v_Capacity_RTOC_Bays	Integer	0	Time Series	Added
v_Capacity_MPCR	Integer	0	Time Series	Added
TRAINING VARIABLES				
v_num_JTX_tngdays	Integer	0	Time Series	Added
v_num_corpsWFX_tngdays	Integer	0	Time Series	Added
v_num_divWFX_tngdays	Integer	0	Time Series	Added
v_num_corpsCPX_tngdays	Integer	0	Time Series	Added
v_num_divCPX_tngdays	Integer	0	Time Series	Added
v_num_JTX_tngdays_rem	Integer	0	Time Series	Added
v_num_corpsWFX_tngdays_rem	Integer	0	Time Series	Added
v_num_divWFX_tngdays_rem	Integer	0	Time Series	Added
v_num_corpsCPX_tngdays_rem	Integer	0	Time Series	Added
v_num_divCPX_tngdays_rem	Integer	0	Time Series	Added
v_num_bde_tngdays_rem	Integer	0	Time Series	Added
v_num_bn_tngdays_rem	Integer	0	Time Series	Added
v_num_co_tngdays_rem	Integer	0	Time Series	Added
v_num_plt_tngdays_rem	Integer	0	Time Series	Added
v_num_JTX_in_rampup	Integer	0	Time Series	Added
v_num_corps_in_rampup	Integer	0	Time Series	Added
v_num_div_in_rampup	Integer	0	Time Series	Added
v_num_JTX_in_execution	Integer	0	Time Series	Added
v_num_corps_in_execution	Integer	0	Time Series	Added
v_num_div_in_execution	Integer	0	Time Series	Added
v_num_JTX_in_recovery	Integer	0	Time Series	Added
v_num_corps_in_recovery	Integer	0	Time Series	Added
v_num_div_in_recovery	Integer	0	Time Series	Added

Model Framework: Resources

Name	Units	Stats	Res Search	Ent Search	Path	Motion	Motion
r_IT_Staff	1	By Unit	Closest	Oldest	Net_BCTC_Staff	Empty: 150 fpm	Full: 150 fpm
r_CT_Staff	1	By Unit	Closest	Oldest	Net_BCTC_Staff	Empty: 150 fpm	Full: 150 fpm
r_SimStim_Staff	1	By Unit	Closest	Oldest	Net_BCTC_Staff	Empty: 150 fpm	Full: 150 fpm
r_TechSpt_Staff	1	By Unit	Closest	Oldest	Net_BCTC_Staff	Empty: 150 fpm	Full: 150 fpm
r_TngSpt_Staff	1	By Unit	Closest	Oldest	Net_BCTC_Staff	Empty: 150 fpm	Full: 150 fpm
r_Networks	1	By Unit	Closest	Oldest	Net_BCTC_Staff	Empty: 150 fpm	Full: 150 fpm

Model Framework: Macros

ID	Options	Type	From	To	Notes
m_BCTC_size	RTI	Numeric Range	0	3	sets the size of the BCTC as small, medium, or large
m_Num_RTOC_Bays_large	RTI	Numeric Range	1	10	sets the initial range for the number of RTOC bays for each BCTC size
m_Num_RTOC_Bays_med	RTI	Numeric Range	1	8	
m_Num_RTOC_Bays_small	RTI	Numeric Range	1	6	
m_num_MPCR_large	RTI	Numeric Range	5	15	sets the initial range for the number of multipurpose classrooms for each BCTC size
m_num_MPCR_medium	RTI	Numeric Range	3	12	
m_num_MPCR_small	RTI	Numeric Range	1	6	
m_num_IT_staff_large	RTI	Numeric Range	15	30	Sets the initial ranges for each of the five types of training staff for each BCTC size
m_num_CT_staff_large	RTI	Numeric Range	15	30	
m_num_simstim_staff_large	RTI	Numeric Range	5	15	
m_num _techspt_staff_large	RTI	Numeric Range	5	15	
m_num_tngspt_staff_large	RTI	Numeric Range	5	15	
m_num_IT_staff_med	RTI	Numeric Range	15	30	
m_num_CT_staff_med	RTI	Numeric Range	15	30	
m_num_simstim_staff_med	RTI	Numeric Range	5	15	
m_num _techspt_staff_med	RTI	Numeric Range	5	15	
m_num_tngspt_staff_med	RTI	Numeric Range	5	15	
m_num_IT_staff_small	RTI	Numeric Range	15	30	
m_num_CT_staff_small	RTI	Numeric Range	15	30	
m_num_simstim_staff_small	RTI	Numeric Range	5	15	
m_num _techspt_staff_small	RTI	Numeric Range	5	15	
m_num_tngspt_staff_small	RTI	Numeric Range	5	15	
m_num_networks_large	RTI	Numeric Range	1	10	Sets the initial ranges for the numbers of networks for each BCTC size
m_num_networks_med	RTI	Numeric Range	1	10	
m_num_networks_small	RTI	Numeric Range	1	10	

Model Framework: User Distributions

ID	Type	Cumulative	Percentage	Value	
d_50_50_Chance	Integer	No	50	1	
			50	0	
d_ind_tng_type	Integer	No	25	0	
			10	1	
			30	2	
			15	3	
			20	4	
d_bns&bn_CPX	Integer	No	60	0	**These distributions are BCTC size-dependent. For example, for a small BCTC, the RTOC bays and TOC pads will only accommodate a Bde and perhaps three or four battalions**
			20	1	
			10	2	
			6	3	
			3	4	
			1	5	
d_bns&bde_CPX	Integer	No	35	0	
			25	1	
			25	2	
			8	3	
			5	4	
			2	5	

Model Framework: Interfaces

Net	Node	Location
Net_DI	n_Release_Point_DI	Loc_Release_Point
	n_MPCR_DI	Loc_MPCR
	n_exit_DI	Loc_Exit
Net_Collective	n_ReleasePt_Collective	Loc_Release_Point
	n_RTOC_Bays	Loc_RTOC_Bays
	n_AAR	Loc_AAR
	n_Exit_Collective	Loc_Exit
Net_Resource	n_res_MPCR	Loc_MPCR
	n_res_RTOC	Loc_RTOC_Bays
	n_res_AAR	Loc_AAR
	n_res_break	Loc_Break

Appendix J: Data Arrays

The following matrices comprise the set of arrays we used in the modeling process. They contain the various data for training events, staff, and networks. With respect to the training events, these data include the number of occurrences per event type, the duration of each (to include the duration of particular phases for WFXs and CPXs), and the total annual event throughput. For the staff and networks, these data included the number of each staff type relative to the BCTC size and event type. We used these arrays primarily for the flexibility they afford in modifying values based on inputs to the model. Thus, instead of constructing three different models for Large, Medium, and Small BCTCs, we were able to create one model and then use the arrays to cue the appropriate data set relative to the BCTC size, which in turn cues certain logic sequences in the model.

Array DI Events

Daily Individual TngEntity Occurrences per BCTC Size

		Adjusted #'s for ARFORGEN		
		Large	Medium	Small
1	e_DI_AFATDS_OPTR	6	5	2
2	e_DI_AFATDS_INT	3	3	1
3	e_DI_AFATDS_LDR	2	1	1
4	e_DI_AFATDS_SUS	10	9	2
8	e_DI_AMPDCS_OPTR	1	1	1
9	e_DI_AMPDCS_INT	1	1	1
10	e_DI_AMPDCS_LDR	1	1	1
11	e_DI_AMPDCS_SUS	1	1	1
12	e_DI_ASAS-L_OPTR	4	4	2
13	e_DI_ASAS-L_INT	3	3	1
14	e_DI_ASAS-L_LDR	1	1	1
15	e_DI_ASAS-L_SUS	8	8	2
16	e_DI_BCS3_OPTR	5	2	0
17	e_DI_BCS3_LDR	1	1	0
18	e_DI_BCS3_SUS	10	4	0
19	e_DI_MCS-L_OPTR	12	12	2
20	e_DI_MCS-L_INT	7	7	2
21	e_DI_MCS-L_LDR	2	2	1
22	e_DI_MCS-L_SUS	24	23	4
23	e_DI_FBCB2_OPTR	57	67	19
24	e_DI_FBCB2_INT	32	37	10
25	e_DI_FBCB2_LDR	9	11	4
26	e_DI_FBCB2_SUS	113	134	37
27	e_DI_FBCB2 ULM_OPTR	3	3	1
28	e_DI_BFT_OPTR	48	0	0
29	e_DI_BFT ULM_OPTR	2	0	0
30	e_DI_DTSS_OPTR	1	1	1
31	e_DI_DTSS_INT	1	1	1

32	e_DI_DTSS_LDR	1	1	1
33	e_DI_DTSS_SUS	2	2	1
34	e_DI_TAIS_OPTR	1	1	1
35	e_DI_TAIS_SUS	1	1	1
36	e_DI_GCSS-A_OPTR	2	2	1
37	e_DI_GCSS-A_SUS	3	3	1
38	e_DI_C2PC_OPTR	1	1	1
39	e_DI_C2PC_LDR	1	1	1
40	e_DI_C2PC_SUS	1	1	1
41	e_DI_CPOF_OPTR	6	6	2
42	e_DI_CPOF_LDR	2	2	1
43	e_DI_JADOCS_OPTR	1	1	1

Array Coll Events

Collective TngEntity Occurrences per BCTC Size
(#'s already adjusted for ARFORGEN)

		Large	Medium	Small
1	e_DC_Plt	144	144	48
2	e_DC_Co	48	48	16
3	e_DC_Bn	33	24	8
4	e_Bn_CPX	23	14	4
5	e_DC_Bde	14	10	3
6	e_Bde_CPX	9	6	2
7	e_Div_CPX	1	2	0
8	e_Div_WFX	1	1	0
9	e_Corps_CPX	1	0	0
10	e_Corps_WFX	1	0	0
11	e_JTX	1	1	0

Array Tng Throughput

Total Annual Training Throughput in #'s of Events

Total Training Throughput		
Large	Medium	Small
276	250	81

Array Staff Reqts

Staff Requirements per BCTC Size

	Large	Medium	Small
IT	22	20	5
CT	21	12	5
SimStim	9	6	1
TechSpt	5	5	1
TngSpt	8	7	2

Array Staff

Staff Requirements per Training Event Type

	IT	CT	SimStim	TechSpt	TngSpt
DI	2	0	0	0.5	1
DC	2	0	0	0.5	1
Bn or BDE CPX	0	3	2	1	1
Bde CPX w/ Bns	0	3	2	1	1
Corps/Div CPX	0	5	2	1	1
JTX/WFX	0	12	6	5	7

Array tng_duration

Training Phase Duration for CPXs and WFXs

	Rampup	Execution	Recovery	TOTAL
WFX	8.00	12.00	1.00	21.00
CPX	3.00	4.00	1.00	8.00

Array Networks

# of Networks Required by Exercise Type & Echelon

	CPX	WFX	JTX
Bn	1	0	0
Bde	1	0	0
Div	2	4	0
Corps	2	4	0
JTX	0	0	4

Array DI tng Duration

# of 24-hour days for Daily Individual Training events

		Duration	
		8 hr days	24 hr days
1	**e_DI_AFATDS_OPTR**	11	3.67
2	**e_DI_AFATDS_INT**	5	1.67
3	**e_DI_AFATDS_LDR**	5	1.67
4	**e_DI_AFATDS_SUS**	5	1.67
5	**e_DI_AFATDS 13F_OPTR**	6	2.00
6	**e_DI_AFATDS 13P_OPTR**	4	1.33
7	**e_DI_AFATDS 13D_OPTR**	5	1.67
8	**e_DI_AMPDCS_OPTR**	9	3.00
9	**e_DI_AMPDCS_INT**	5	1.67
10	**e_DI_AMPDCS_LDR**	6	2.00
11	**e_DI_AMPDCS_SUS**	5	1.67

12	**e_DI_ASAS-L_OPTR**	11	3.67
13	**e_DI_ASAS-L_INT**	5	1.67
14	**e_DI_ASAS-L_LDR**	6	2.00
15	**e_DI_ASAS-L_SUS**	5	1.67
16	**e_DI_BCS3_OPTR**	6	2.00
17	**e_DI_BCS3_LDR**	3	1.00
18	**e_DI_BCS3_SUS**	5	1.67
19	**e_DI_MCS-L_OPTR**	6	2.00
20	**e_DI_MCS-L_INT**	5	1.67
21	**e_DI_MCS-L_LDR**	6	2.00
22	**e_DI_MCS-L_SUS**	4	1.33
23	**e_DI_FBCB2_OPTR**	6	2.00
24	**e_DI_FBCB2_INT**	5	1.67
25	**e_DI_FBCB2_LDR**	6	2.00
26	**e_DI_FBCB2_SUS**	6	2.00
27	**e_DI_FBCB2 ULM_OPTR**	6	2.00
28	**e_DI_BFT_OPTR**	6	2.00
29	**e_DI_BFT ULM_OPTR**	6	2.00
30	**e_DI_DTSS_OPTR**	5	1.67
31	**e_DI_DTSS_INT**	5	1.67
32	**e_DI_DTSS_LDR**	5	1.67
33	**e_DI_DTSS_SUS**	4	1.33
34	**e_DI_TAIS_OPTR**	6	2.00
35	**e_DI_TAIS_SUS**	4	1.33
36	**e_DI_GCSS-A_OPTR**	6	2.00
37	**e_DI_GCSS-A_SUS**	4	1.33
38	**e_DI_C2PC_OPTR**	4	1.33
39	**e_DI_C2PC_LDR**	4	1.33
40	**e_DI_C2PC_SUS**	4	1.33
41	**e_DI_CPOF_OPTR**	2	0.67
42	**e_DI_CPOF_LDR**	2	0.67
43	**e_DI_JADOCS_OPTR**	6	2.00

Appendix K: Model Logic Sequences

The following tables contain all of the logic and code developed for the analytical simulation model. We have organized the tables to reflect the modular approach we took when building our model. Essentially, we developed all coded sequences in MS Word first to facilitate rapid coding of the model. Once we completed our sequences and had them reviewed (in modules) by subject matter experts, we copied them into the model and compiled them. As we compiled and verified the code sequences, we then recopied those sequences back into our initial MS Word document as a back-up repository for our code.

INITIALIZATION LOGIC	
Entity	**Logic**
ALL	//set all common attributes and variables WAIT 1 day v_num_total_entities_start = 0 v_num_total_entities_in_BCTC = 0 v_num_JTX = 0 v_num_corpsWFX = 0 v_num_corpsCPX = 0 v_num_divWFX = 0 v_num_divCPX = 0 v_num_bde_DC = 0 v_num_bde_CPX = 0 v_num_bn_DC = 0 v_num_bn_CPX = 0 v_num_co = 0 v_num_plt = 0 v_num_JTX_start = 0 v_num_corpsWFX_start = 0 v_num_corpsCPX_start = 0 v_num_divWFX_start = 0 v_num_divCPX_start = 0 v_num_bde_DC_start = 0 v_num_bde_CPX_start = 0 v_num_bn_DC_start = 0 v_num_bn_CPX_start = 0 v_num_co_start = 0 v_num_plt_start = 0 v_num_DI_start = 0 v_num_bns_needed_in_BdeSA = 0 v_num_bns_needed_in_BnSA = 0 v_num_bns_in_bnSA = 0 v_num_bde_in_bdeSA = 0 v_num_JTX_in_BCTC = 0 v_num_corpsWFX_in_BCTC = 0

	``` v_num_corpsCPX_in_BCTC = 0 v_num_divWFX_in_BCTC = 0 v_num_divCPX_in_BCTC = 0 v_num_bde_DC_in_BCTC = 0 v_num_bde_CPX_in_BCTC = 0 v_num_bn_DC_in_BCTC = 0 v_num_bn_CPX_in_BCTC = 0 v_num_co_in_BCTC = 0 v_num_plt_in_BCTC = 0 v_num_DI_in_BCTC = 0 ```

```
v_num_corpsCPX_in_BCTC = 0
v_num_divWFX_in_BCTC = 0
v_num_divCPX_in_BCTC = 0
v_num_bde_DC_in_BCTC = 0
v_num_bde_CPX_in_BCTC = 0
v_num_bn_DC_in_BCTC = 0
v_num_bn_CPX_in_BCTC = 0
v_num_co_in_BCTC = 0
v_num_plt_in_BCTC = 0
v_num_DI_in_BCTC = 0

//set resources, macros, and variables based on BCTC size

IF (v_BCTC_size < 1) THEN
{
   //set variables for large BCTC
   v_BCTC_size = m_BCTC_size
   IF v_BCTC_size = 1 THEN
   {

      v_num_IT_staff = m_num_IT_staff_large
      v_num_IT_staff = m_num_CT_staff_large
      v_num_SimStim_staff = m_num_SimStim_staff_large
      v_num_TechSpt_staff = m_num_TechSpt_staff_large
      v_num_TngSpt_staff = m_num_TngSpt_staff_large
      v_num_networks = m_num_networks_large
      v_num_RTOC_bays = m_num_RTOC_bays_large
      v_num_RTOC_bays_avail = v_num_RTOC_bays
      v_num_MPCR = m_num_MPCR_large
      v_num_MPCR_avail = v_num_MPCR
      v_num_MPAAR = m_num_MPAAR_large
      v_num_MPAAR_avail = v_num_MPAAR
   } //end IF v_BCTC_size = 1

   //set variables for Medium BCTC
   ELSE IF v_BCTC_size = 2 THEN
   {
      v_num_IT_staff = m_num_IT_staff_med
      v_num_IT_staff = m_num_CT_staff_med
      v_num_SimStim_staff = m_num_SimStim_staff_med
      v_num_TechSpt_staff = m_num_TechSpt_staff_med
      v_num_TngSpt_staff = m_num_TngSpt_staff_med
      v_num_networks = m_num_networks_med
      v_num_RTOC_bays = m_num_RTOC_bays_med
      v_num_RTOC_bays_avail = v_num_RTOC_bays
      v_num_MPCR = m_num_MPCR_med
      v_num_MPCR_avail = v_num_MPCR
      v_num_MPAAR = m_num_MPAAR_med
      v_num_MPAAR_avail = v_num_MPAAR

   } // end ELSE IF v_BCTC_size = 2

   //set variables for small BCTC
   ELSE IF v_BCTC_size = 3 THEN
   {
      v_num_IT_staff = m_num_IT_staff_small
      v_num_IT_staff = m_num_CT_staff_small
```

	`v_num_SimStim_staff = m_num_SimStim_staff_small`
	`v_num_TechSpt_staff = m_num_TechSpt_staff_small`
	`v_num_TngSpt_staff = m_num_TngSpt_staff_small`
	`v_num_networks = m_num_networks_small`
	`v_num_RTOC_bays = m_num_RTOC_bays_small`
	`v_num_RTOC_bays_avail = v_num_RTOC_bays`
	`v_num_MPCR = m_num_MPCR_small`
	`v_num_MPCR_avail = v_num_MPCR`
	`v_num_MPAAR = m_num_MPAAR_small`
	`v_num_MPAAR_avail = v_num_MPAAR`
	`} //end ELSE IF v_BCTC_size = 3`
	`} //end set variables for BCTC size`

LOGIC FOR LOC_START	
Entity	**Logic**
e_DI_AFATDS_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 1 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[1,2] a_entity_priority = 2
e_DI_AFATDS_INT	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 2 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[2,2] a_entity_priority = 2
e_DI_AFATDS_LDR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 3 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[3,2] a_entity_priority = 2
e_DI_AFATDS_SUS	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 4 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[4,2] a_entity_priority = 2
e_DI_AMPDCS_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 8 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[8,2] a_entity_priority = 2

e_DI_AMPDCS_INT	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 9 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[9,2] a_entity_priority = 2
e_DI_AMPDCS_LDR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 10 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[10,2] a_entity_priority = 2
e_DI_AMPDCS_SUS	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 11 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[11,2] a_entity_priority = 2
e_DI_ASAS-L_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 12 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[12,2] a_entity_priority = 2
e_DI_ASAS-L_INT	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 13 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[13,2] a_entity_priority = 2
e_DI_ASAS-L_LDR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 14 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[14,2] a_entity_priority = 2
e_DI_ASAS-L_SUS	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 15 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[15,2] a_entity_priority = 2
e_DI_BCS3_OPTR	//set all attributes

	INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 16 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[16,2] a_entity_priority = 2
e_DI_BCS3_LDR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 17 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[17,2] a_entity_priority = 2
e_DI_BCS3_SUS	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 18 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[18,2] a_entity_priority = 2
e_DI_MCS-L_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 19 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[19,2] a_entity_priority = 2
e_DI_MCS-L_INT	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 20 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[20,2] a_entity_priority = 2
e_DI_MCS-L_LDR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 21 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[21,2] a_entity_priority = 2
e_DI_MCS-L_SUS	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 22 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[22,2] a_entity_priority = 2
e_DI_FBCB2_OPTR	//set all attributes INC v_num_total_entities_start, 1

	INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 23 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[23,2] a_entity_priority = 2
e_DI_FBCB2_INT	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 24 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[24,2] a_entity_priority = 2
e_DI_FBCB2_LDR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 25 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[25,2] a_entity_priority = 2
e_DI_FBCB2_SUS	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 26 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[26,2] a_entity_priority = 2
e_DI_FBCB2_ULM_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 27 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[27,2] a_entity_priority = 2
e_DI_BFT_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 28 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[28,2] a_entity_priority = 2
e_DI_BFT_ULM_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 29 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[29,2] a_entity_priority = 2
e_DI_DTSS_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1

	a_creation_num = v_num_total_entities_start a_entity_ref_num = 30 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[30,2] a_entity_priority = 2
e_DI_DTSS_INT	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 31 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[31,2] a_entity_priority = 2
e_DI_DTSS_LDR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 32 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[32,2] a_entity_priority = 2
e_DI_DTSS_SUS	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 33 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[33,2] a_entity_priority = 2
e_DI_TAIS_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 34 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[34,2] a_entity_priority = 2
e_DI_TAIS_SUS	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 35 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[35,2] a_entity_priority = 2
e_DI_GCSS-A_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 36 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[36,2] a_entity_priority = 2
e_DI_GCSS-A_SUS	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start

	a_entity_ref_num = 37 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[37,2] a_entity_priority = 2
e_DI_C2PC_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 38 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[38,2] a_entity_priority = 2
e_DI_C2PC_LDR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 39 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[39,2] a_entity_priority = 2
e_DI_C2PC_SUS	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 40 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[40,2] a_entity_priority = 2
e_DI_CPOF_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 41 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[41,2] a_entity_priority = 2
e_DI_CPOF_LDR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 42 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[42,2] a_entity_priority = 2
e_DI_JADOCS_OPTR	//set all attributes INC v_num_total_entities_start, 1 INC v_num_DI_start, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 43 a_entity_type = 8 a_entity_tng_duration = arr_DI_tng_duration[43,2] a_entity_priority = 2
e_DC_Platoon	//set all attributes INC v_num_total_entities_start, 1 INC v_num_plt_start, 1 INC v_num_plt, 1 a_creation_num = v_num_total_entities_start

	a_entity_ref_num = 44 a_entity_type = 7 a_entity_tng_type = 4 a_entity_tng_duration = N((2/3), .1) a_entity_priority = 2
e_DC_Company	//set all attributes INC v_num_total_entities_start, 1 INC v_num_co_start, 1 INC v_num_co, 1 a_creation_num = v_num_total_entities_start a_entity_ref_num = 45 a_entity_type = 6 a_entity_tng_type = 4 a_entity_tng_duration = N((2/3),.1) a_entity_priority = 2

e_DC_Bn	//set all attributes
	INC v_num_bn_DC, 1
	IF (v_num_bn_DC > arr_coll_events[3, (v_BCTC_size)]) THEN
	{
	   DEC v_num_bn_DC, 1
	   //move out of BCTC
	   ROUTE 2
	}
	ELSE
	{
	   INC v_num_total_entities_start, 1
	   INC v_num_Bn_DC_start, 1
	   a_creation_num = v_num_total_entities_start
	   a_entity_ref_num = 46
	   a_entity_type = 5
	   a_entity_tng_type = 4
	   a_entity_tng_duration = N((4/3),.5)
	   a_entity_priority = 2
	   ROUTE 1
	}

e_DC_Bde	//set all attributes
	INC v_num_bde_DC, 1
	IF (v_num_bde_DC > arr_coll_events[5, (v_BCTC_size)]) THEN
	{
	   DEC v_num_bde_DC, 1
	   //move out of BCTC
	   ROUTE 2
	}
	ELSE
	{
	   INC v_num_total_entities_start, 1
	   INC v_num_Bde_DC_start, 1
	   a_creation_num = v_num_total_entities_start
	   a_entity_ref_num = 47
	   a_entity_type = 4
	   a_entity_tng_type = 4
	   a_entity_tng_duration = N((4/3),.5)
	   a_entity_priority = 2
	   ROUTE 1
	}

e_Bn_CPX

```
//set all attributes

INC v_num_bn_CPX, 1
IF (v_num_bn_CPX > arr_coll_events[4, v_BCTC_size]) THEN
{
   //exit the BCTC
   ROUTE 3
}

ELSE
{
   INC v_num_total_entities_start, 1
   INC v_num_bn_CPX_start, 1
   a_creation_num = v_num_total_entities_start
   a_entity_ref_num = 48
   a_entity_type = 5
   a_entity_priority = 1.1
   a_entity_tng_type = 3
   a_entity_tng_duration = N(5,1)
   a_entity_RTOC_bays_reqd = 1

   IF (v_num_bns_needed_in_BdeSA > 0) THEN
   {
      DEC v_num_bns_needed_in_BdeSA, 1
      INC v_num_bns_loaded_w_bde, 1
      //move to Bde Staging Area on unique route and Load on Bde entity
(routing rule LOAD 1)
      ROUTE 2
   }//end else if


   ELSE
   {
      //move to Location Entrance Queue
      ROUTE 1
   } //end else
}
```

e_Bde_CPX

```
//set all attributes

INC v_num_bde_CPX, 1
IF (v_num_bde_CPX > arr_coll_events[6, (v_BCTC_size)]) THEN
{
   DEC v_num_bde_CPX, 1
   ROUTE 3
}

ELSE
{
   INC v_num_total_entities_start, 1
   INC v_num_bde_CPX_start, 1
   a_creation_num = v_num_total_entities_start
```

```
   a_entity_ref_num = 49
   a_entity_type = 4
   a_entity_priority = 1.2
   a_entity_tng_type = 3
   a_entity_tng_duration = N(6,1)
   a_entity_RTOC_bays_reqd = 2

//specify whether the bde is here to train alone or w/ bns
   a_num_bns_w_bde = d_bns_w_bde_CPX()
   IF (a_num_bns_w_bde > 0) THEN
   {
      a_entity_tng_type = 3.5
      //check if there are enough Bn CPX entities remaining to load with
      IF (a_num_bns_w_bde > (arr_coll_events[5, (v_BCTC_size)] - v_num_bn_CPX
- v_num_bns_needed_in_BdeSA)) THEN
      {
         a_num_bns_w_bde = (arr_coll_events[5, (v_BCTC_size)] - v_num_bn_CPX
- v_num_bns_needed_in_BdeSA)
         // Reset to 0 needed if tno more Bns are due to arrive
         IF a_num_bns_w_bde < 0 THEN
         {
           a_num_bns_w_bde  = 0
         } // end no more Bns coming into simulation
      } //end if
      a_entity_RTOC_bays_reqd = (2 + a_num_bns_w_bde)
      INC v_num_bde_in_BdeSA, 1
      INC v_num_bns_needed_in_BdeSA, (a_num_bns_w_bde)

      //move to Bde Staging Area to await bns to train with
      ROUTE 2
   }//end if

   ELSE
   {
      //move to Location Entrance Queue
      ROUTE 1
   } //end else
}
```

e_Div_CPX

```
//set all attributes

INC v_num_divCPX, 1
IF (v_num_divCPX > arr_coll_events[7, (v_BCTC_size)]) THEN
{
   INC v_num_divCPX_renigs, 1
   DEC v_num_divCPX, 1
   ROUTE 2
}
ELSE
{
   INC v_num_total_entities_start, 1
   INC v_num_DivCPX_start, 1
   a_creation_num = v_num_total_entities_start
   a_entity_ref_num = 50
   a_entity_type = 3
   a_entity_priority = 1.2
   a_entity_tng_type = 3
   a_entity_CT_staff_reqd = arr_staff[5,2]
```

	a_entity_simstim_staff_reqd = arr_staff[5,3] a_entity_techspt_staff_reqd = arr_staff[5,4] a_entity_tngspt_staff_reqd = arr_staff[5,5] a_entity_num_networks_reqd = arr_networks[3, 1] a_entity_tng_duration = arr_tng_duration[2, 4] a_entity_tng_rampup_days = arr_tng_duration[2, 1] a_entity_tng_execution_days = arr_tng_duration[2, 2] a_entity_tng_recovery_days = arr_tng_duration[2, 3] ROUTE 1 }

e_Corps_CPX	//set all attributes
	INC v_num_corpsCPX, 1
	IF (v_num_corpsCPX > arr_coll_events[9, (v_BCTC_size)]) THEN
	{
	INC v_num_corpsCPX_renigs, 1
	DEC v_num_corpsCPX, 1
	ROUTE 1
	}
	ELSE
	{
	INC v_num_total_entities_start, 1
	INC v_num_corpsCPX_start, 1
	a_creation_num = v_num_total_entities_start
	a_entity_ref_num = 51
	a_entity_type = 2
	a_entity_priority = 1.2
	a_entity_tng_type = 3
	a_entity_CT_staff_reqd = arr_staff[5,2]
	a_entity_simstim_staff_reqd = arr_staff[5,3]
	a_entity_techspt_staff_reqd = arr_staff[5,4]
	a_entity_tngspt_staff_reqd = arr_staff[5,5]
	a_entity_num_networks_reqd = arr_networks[4, 1]
	a_entity_tng_duration = arr_tng_duration[2, 4]
	a_entity_tng_rampup_days = arr_tng_duration[2, 1]
	a_entity_tng_execution_days = arr_tng_duration[2, 2]
	a_entity_tng_recovery_days = arr_tng_duration[2, 3]
	ROUTE 1
	}

e_Div_WFX	//set all attributes
	INC v_num_divWFX, 1
	IF (v_num_divWFX > arr_coll_events[8, (v_BCTC_size)]) OR (v_num_corpsWFX >= 1) OR (v_num_JTX >= 1) THEN
	{
	INC v_num_divWFX_renigs, 1
	DEC v_num_divWFX, 1
	ROUTE 2
	}
	ELSE
	{
	INC v_num_divWFX_start, 1
	INC v_num_total_entities_start, 1
	IF (v_BCTC_size = 1) THEN
	{
	INC v_num_corpsWFX, 1
	INC v_num_corpsWFX_start, 1

	INC v_num_JTX, 1
	      INC v_num_JTX_start, 1
	      INC v_num_total_entities_start, 2
	   }
	   ELSE IF (v_BCTC_size = 2) THEN
	   {
	      INC v_num_JTX, 1
	      INC v_num_JTX_start, 1
	      INC v_num_total_entities_start, 1
	   }
	
	   INC v_num_bde_CPX, 5
	   IF (v_num_bde_CPX > arr_coll_events[6, (v_BCTC_size)]) THEN
	   {
	      IF ((5 - (v_num_bde_CPX - arr_coll_events[6, (v_BCTC_size)])) > 0) THEN
	      {
	         INC v_num_bde_CPX_start, (5 - (v_num_bde_CPX - arr_coll_events[6, (v_BCTC_size)]))
	         v_num_bde_CPX_w_divWFX = (5 - (v_num_bde_CPX - arr_coll_events[6, (v_BCTC_size)]))
	         DEC v_num_bde_CPX, (v_num_bde_CPX - arr_coll_events[6, (v_BCTC_size)])
	         INC v_num_total_entities_start, v_num_bde_CPX_w_divWFX
	      }
	      ELSE
	      {
	         DEC v_num_bde_CPX, 5
	      }//end if-then-else #3
	   }
	   ELSE
	   {
	      INC v_num_bde_CPX_start, 5
	      v_num_bde_CPX_w_divWFX = 5
	      INC v_num_total_entities_start, 5
	   }//end if-then-else#2
	
	   a_creation_num = v_num_total_entities_start
	   a_entity_ref_num = 52
	   a_entity_type = 3
	   a_entity_priority = 1.5
	   a_entity_tng_type = 2
	   a_entity_CT_staff_reqd = arr_staff[6,2]
	   a_entity_simstim_staff_reqd = arr_staff[6,3]
	   a_entity_techspt_staff_reqd = arr_staff[6,4]
	   a_entity_tngspt_staff_reqd = arr_staff[6,5]
	   a_entity_num_networks_reqd = arr_networks[3, 2]
	   a_entity_tng_duration = arr_tng_duration[1, 4]
	   a_entity_tng_rampup_days = arr_tng_duration[1, 1]
	   a_entity_tng_execution_days = arr_tng_duration[1, 2]
	   a_entity_tng_recovery_days = arr_tng_duration[1, 3]
	   ROUTE 1
	}

e_Corps_WFX	//set all attributes
	INC v_num_corpsWFX, 1
	IF (v_num_corpsWFX > arr_coll_events[10, (v_BCTC_size)]) OR (v_num_divWFX >= 1) OR (v_num_JTX >= 1) THEN

	``
	{
	   INC v_num_corpsWFX_renigs, 1
	   DEC v_num_corpsWFX, 1
	   ROUTE 2
	}
	
	ELSE
	{
	   INC v_num_corpsWFX_start, 1
	   INC v_num_total_entities_start, 1
	   INC v_num_JTX, 1
	   INC v_num_JTX_start, 1
	   INC v_num_total_entities_start, 1
	   INC v_num_divWFX, 1
	// IF (v_num_divWFX > arr_coll_events[8, (v_BCTC_size)]) THEN
	// {
	// DEC v_num_divWFX, 1
	// }
	// ELSE
	// {
	
	   INC v_num_divWFX_start, 1
	   v_num_divWFX_w_corpsWFX = 1
	   INC v_num_total_entities_start, 1
	
	// }
	
	   INC v_num_bde_CPX, 5
	   IF (v_num_bde_CPX > arr_coll_events[6, (v_BCTC_size)]) THEN
	   {
	      IF ((5 - (v_num_bde_CPX - arr_coll_events[6, (v_BCTC_size)])) > 0)
	THEN
	      {
	         INC v_num_bde_CPX_start, (5 - (v_num_bde_CPX - arr_coll_events[6,
	(v_BCTC_size)]))
	         v_num_bde_CPX_w_corpsWFX = (5 - (v_num_bde_CPX -
	arr_coll_events[6, (v_BCTC_size)]))
	         DEC v_num_bde_CPX, (v_num_bde_CPX - arr_coll_events[6,
	(v_BCTC_size)])
	         INC v_num_total_entities_start, v_num_bde_CPX_w_corpsWFX
	      }
	      ELSE
	      {
	         DEC v_num_bde_CPX, 5
	      }
	   }
	   ELSE
	   {
	      INC v_num_bde_CPX_start, 5
	      v_num_bde_CPX_w_corpsWFX = 5
	      INC v_num_total_entities_start, 5
	   }
	
	   a_creation_num = v_num_total_entities_start
	   a_entity_ref_num = 53
	   a_entity_type = 2
	   a_entity_priority = 1.5
	``

```
   a_entity_tng_type = 2
   a_entity_CT_staff_reqd = arr_staff[6,2]
   a_entity_simstim_staff_reqd = arr_staff[6,3]
   a_entity_techspt_staff_reqd = arr_staff[6,4]
   a_entity_tngspt_staff_reqd = arr_staff[6,5]
   a_entity_num_networks_reqd = arr_networks[4, 2]
   a_entity_tng_duration = arr_tng_duration[1, 4]
   a_entity_tng_rampup_days = arr_tng_duration[1, 1]
   a_entity_tng_execution_days = arr_tng_duration[1, 1]
   a_entity_tng_recovery_days = arr_tng_duration[1, 1]
   ROUTE 1
}
```

e_JTX

```
//set all attributes
INC v_num_JTX, 1
IF (v_num_JTX > arr_coll_events[11, (v_BCTC_size)]) OR (v_num_corpsWFX >=
1) OR (v_num_divWFX >= 1)THEN
{
   INC v_num_JTX_renigs, 1
   DEC v_num_JTX, 1
   ROUTE 2
}

ELSE
{
   INC v_num_JTX_start, 1
   INC v_num_total_entities_start, 1
   IF (v_BCTC_size = 1) THEN
   {
      INC v_num_corpsWFX, 1
      INC v_num_corpsWFX_start, 1
      v_num_corpsWFX_w_JTX = 1
      INC v_num_divWFX, 1
      INC v_num_divWFX_start, 1
      v_num_divWFX_w_JTX = 1
      INC v_num_total_entities_start, 2
   }
   ELSE IF (v_BCTC_size = 2) THEN
   {
      INC v_num_divWFX, 1
      INC v_num_divWFX_start, 1
      INC v_num_total_entities_start, 1
   }

   INC v_num_bde_CPX, 5
   IF (v_num_bde_CPX > arr_coll_events[6, (v_BCTC_size)]) THEN
   {
       IF ((5 - (v_num_bde_CPX - arr_coll_events[6, (v_BCTC_size)])) > 0)
THEN
      {
         INC v_num_bde_CPX_start, (5 - (v_num_bde_CPX - arr_coll_events[6,
(v_BCTC_size)]))
         v_num_bde_CPX_w_JTX = (5 - (v_num_bde_CPX - arr_coll_events[6,
(v_BCTC_size)]))
         DEC v_num_bde_CPX, (v_num_bde_CPX - arr_coll_events[6,
(v_BCTC_size)])
         INC v_num_total_entities_start, v_num_bde_CPX_w_JTX
      }
```

```
      ELSE
      {
         DEC v_num_bde_CPX, 5
      }
   }
   ELSE
   {
      INC v_num_bde_CPX_start, 5
      v_num_bde_CPX_w_JTX = 5
      INC v_num_total_entities_start, 5
   }
// DISPLAY "A JTX has arrived and has "$v_num_corpsWFX_w_JTX$" and
"$v_num_divWFX_w_JTX$" and "$v_num_bde_CPX_w_JTX$ "with it"
   a_creation_num = v_num_total_entities_start
   a_entity_ref_num = 54
   a_entity_type = 1
   a_entity_priority = 1
   a_entity_tng_type = 1
   a_entity_CT_staff_reqd = arr_staff[6,2]
   a_entity_simstim_staff_reqd = arr_staff[6,3]
   a_entity_techspt_staff_reqd = arr_staff[6,4]
   a_entity_tngspt_staff_reqd = arr_staff[6,5]
   a_entity_num_networks_reqd = arr_networks[5, 3]
   a_entity_tng_duration = arr_tng_duration[1, 4]
   a_entity_tng_rampup_days = arr_tng_duration[1, 1]
   a_entity_tng_execution_days = arr_tng_duration[1, 2]
   a_entity_tng_recovery_days = arr_tng_duration[1, 3]
   ROUTE 1
}
```

LOGIC FOR LOC_BDE_STAGING_AREA

ALL

```
//Load (a_num_bns_w_bde) worth of bns with the waiting bde and then send
to entrance queue

//DISPLAY "Bde in SA to load" $a_num_bns_w_bde$ "bns"
//DISPLAY "a_num_bns_w_bde is currently: ",a_num_bns_w_bde
//DEBUG

LOAD (a_num_bns_w_bde) in 30 day

//DISPLAY "loaded" $v_num_bns_loaded_w_bde$ "bns, which is "
$(a_num_bns_w_bde - v_num_bns_loaded_w_bde)$ "less than was originally
needed"

IF (v_num_bns_loaded_w_bde < a_num_bns_w_bde) THEN
{
   DEC v_num_bns_needed_in_bdeSA, (a_num_bns_w_bde -
v_num_bns_loaded_w_bde)
   a_num_bns_w_bde = v_num_bns_loaded_w_bde
}
//DISPLAY "the attribute a_num_bns_w_bde is now: ", a_num_bns_w_bde

DEC v_num_bde_in_BdeSA, 1
DEC v_num_bns_loaded_w_bde, a_num_bns_w_bde
```

	IF (v_num_bns_needed_in_BdeSA >= a_num_bns_w_bde) THEN
	{
	   DEC v_num_bns_needed_in_BdeSA, (a_num_bns_w_bde)
	}
	
	ROUTE 1

LOGIC FOR LOC_HOLDING_AREA	
ALL	INC v_num_entities_in_HA, 1 WAIT .02 day DEC v_num_entities_in_HA, 1 ROUTE 1

LOGIC FOR LOC_Release_Point

ALL

```
//WHAT TYPE OF ENTITY IS TRYING TO ENTER THE BCTC?

// Can a DI or company or platoon entity enter?

IF (a_entity_type = 6) OR (a_entity_type = 7) OR (a_entity_type = 8) THEN
{
   a_entity_IT_staff_reqd = arr_staff[1,1]
   a_entity_techspt_staff_reqd = arr_staff[1,4]
   a_entity_tngspt_staff_reqd = arr_staff[1,5]

   //Are there any Corps or Div WFX's going on?
   IF (v_num_JTX_in_BCTC > 0) OR (v_num_corpsWFX_in_BCTC > 0) OR (v_num_corpsCPX_in_BCTC > 0) OR
(v_num_divWFX_in_BCTC > 0) OR (v_num_divCPX_in_BCTC > 0) THEN
   {
      //Are there classrooms and resources available and is there sufficient time left in the ramp-up phase for
the WFX?

      IF (v_num_JTX_in_rampup_phase > 0) OR (v_num_corpsWFX_in_rampup_phase > 0) OR (v_num_divWFX_in_rampup_phase
> 0) OR (v_num_corpsCPX_in_rampup_phase > 0) OR (v_num_divCPX_in_rampup_phase > 0)THEN
      {
         IF (a_entity_tng_duration < v_num_rampup_days_rem) AND (v_num_MPCR_avail > 0) AND (FREEUNITS(r_IT_staff)
>= a_entity_IT_staff_reqd) THEN
         {
            a_entity_start_tng = clock(DAY)
            DEC v_num_MPCR_avail, 1
            INC v_num_total_entities_in_BCTC, 1
            IF (a_entity_type = 6) THEN
            {
               INC v_num_co_in_BCTC, 1
            }
            ELSE IF (a_entity_type = 7) THEN
            {
               INC v_num_plt_in_BCTC, 1
            }
            ELSE
            {
               INC v_num_DI_in_BCTC, 1
            }
```

```
            // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY; ROUTE 1
            ROUTE 1
         }
         ELSE
         {
            //move entity to loc_holding_area & WAIT 1 DAY
            ROUTE 2
         }
      }
      ELSE IF (v_num_corps_in_execution_phase > 0) OR (v_num_div_in_execution_phase > 0) OR
(v_num_JTX_in_execution_phase > 0) THEN
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      }
      ELSE IF(v_num_MPCR_avail > 0) AND (FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd)THEN
      {
         a_entity_start_tng = clock(DAY)
         DEC v_num_MPCR_avail, 1
         INC v_num_total_entities_in_BCTC, 1
         IF (a_entity_type = 6) THEN
         {
            INC v_num_co_in_BCTC, 1
         }
         ELSE IF (a_entity_type = 7) THEN
         {
            INC v_num_plt_in_BCTC, 1
         }
         ELSE
         {
            INC v_num_DI_in_BCTC, 1
         }
         // move entity to loc_MPCR & WAIT (a_entity_tng_duration)
         ROUTE 1
      }
      ELSE
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      }
   } // end if JTX of corps/div WFX/CPX > 0
```

```
   ELSE IF (v_num_MPCR_avail > 0) AND (FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd) THEN
   {
      a_entity_start_tng = clock(DAY)
      DEC v_num_MPCR_avail, 1
      INC v_num_total_entities_in_BCTC, 1
      IF (a_entity_type = 6) THEN
      {
        INC v_num_co_in_BCTC, 1
      }
      ELSE IF (a_entity_type = 7) THEN
      {
        INC v_num_plt_in_BCTC, 1
      }
      ELSE
      {
        INC v_num_DI_in_BCTC, 1
      }
      // move entity to loc_MPCR & WAIT (a_entity_tng_duration)
      ROUTE 1
   } // end else if (v_num_MPCR_avail > 0)

   ELSE
   {
      // move entity to loc_holding_area & WAIT 1 DAY
      ROUTE 2 // I am here (test #9999)
   } // end "are there any Corps or Div WFXs going on?"
} // end if (a_entity_type = 6) OR (a_entity_type = 7) OR (a_entity_type = 8)

//Can a JTX entity enter the facility?

ELSE IF (a_entity_type = 1) THEN
{
    //check if there are any corps, div, or JTX events in the BCTC
    IF (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0) OR (v_num_bde_CPX_in_BCTC >
0) OR (v_num_bn_CPX_in_BCTC > 0) THEN
    {
       // move entity to loc_holding_area & WAIT 1 DAY
       ROUTE 2
    }
```

```
    //check if there are any bde, bn, co, plt, or DI classroom training events going on in the BCTC
    ELSE IF (v_num_bde_DC_in_BCTC > 0) OR (v_num_bn_DC_in_BCTC > 0) OR (v_num_co_in_BCTC > 0) OR
(v_num_plt_in_BCTC > 0) OR (v_num_DI_in_BCTC > 0) THEN
    {
        IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) AND ((v_num_DC_tngdays_rem < a_entity_tng_rampup_days) OR
(v_num_DI_tngdays_rem < a_entity_tng_rampup_days)) AND ((FREEUNITS(r_simstim_staff) >=
a_entity_simstim_staff_reqd) AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND
(FREEUNITS(r_tngspt_staff) >= a_entity_tngspt_staff_reqd)) THEN
        {
           a_entity_start_tng = clock(DAY)
           DEC v_num_RTOC_bays_avail, v_num_RTOC_bays
           INC v_num_total_entities_in_BCTC, 1
           INC v_num_JTX_in_BCTC, 1
           INC v_num_corpsWFX_in_BCTC, 1
           INC v_num_corps_in_BCTC, 1
           INC v_num_total_entities_in_BCTC, 1
           IF (v_num_divWFX_w_JTX > 0) THEN
           {
              INC v_num_divWFX_in_BCTC, 1
              INC v_num_div_in_BCTC, 1
              INC v_num_total_entities_in_BCTC, 1
           }
           IF (v_num_bde_CPX_w_JTX > 0) THEN
           {
              INC v_num_bde_CPX_in_BCTC, v_num_bde_CPX_w_JTX
              INC v_num_total_entities_in_BCTC, v_num_bde_CPX_w_JTX
           }

           // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
           ROUTE 3
        }
        ELSE
        {
           // move entity to loc_holding_area & WAIT 1 DAY
           ROUTE 2
        } // end else
    } // end else if Bde/Bn in BCTC

    ELSE IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) AND ((FREEUNITS(r_simstim_staff) >=
a_entity_simstim_staff_reqd) AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND
(FREEUNITS(r_tngspt_staff) >= a_entity_tngspt_staff_reqd)) THEN
```

```
    {
        a_entity_start_tng = clock(DAY)
        DEC v_num_RTOC_bays_avail, v_num_RTOC_bays
        INC v_num_total_entities_in_BCTC, 1
        INC v_num_JTX_in_BCTC, 1
        INC v_num_corpsWFX_in_BCTC, 1
        INC v_num_corps_in_BCTC, 1
        INC v_num_total_entities_in_BCTC, 1
        IF (v_num_divWFX_w_JTX > 0) THEN
        {
           INC v_num_divWFX_in_BCTC, 1
           INC v_num_div_in_BCTC, 1
           INC v_num_total_entities_in_BCTC, 1
        }
        IF (v_num_bde_CPX_w_JTX > 0) THEN
        {
           INC v_num_bde_CPX_in_BCTC, v_num_bde_CPX_w_JTX
           INC v_num_total_entities_in_BCTC, v_num_bde_CPX_w_JTX
        }
        // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
        ROUTE 3
    } //end else if

    ELSE
    {
        // move entity to loc_holding_area
        ROUTE 2
    } // end else
} //end ELSE IF (a_entity_type = 1)


//Can a Corps entity enter the facility?

ELSE IF (a_entity_type = 2) THEN
{
   //check if corps WFX can enter
   IF (a_entity_tng_type < 3) THEN
   {
      //check if there are any corps, div, or JTX events in the BCTC
      IF (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0) OR (v_num_bde_CPX_in_BCTC
> 0) OR (v_num_bn_CPX_in_BCTC > 0) THEN
```

```
      {
         // move entity to loc_holding_area
         ROUTE 2
      }

      //check if there are any bde, bn, co, plt, or DI classroom training events going on in the BCTC
      ELSE IF (v_num_bde_DC_in_BCTC > 0) OR (v_num_bn_DC_in_BCTC > 0) OR (v_num_co_in_BCTC > 0) OR
(v_num_plt_in_BCTC > 0) OR (v_num_DI_in_BCTC > 0) THEN
      {
         IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) AND ((v_num_DC_tngdays_rem < a_entity_tng_rampup_days) OR
(v_num_DI_tngdays_rem < a_entity_tng_rampup_days)) AND ((FREEUNITS(r_simstim_staff) >=
a_entity_simstim_staff_reqd) AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND
(FREEUNITS(r_tngspt_staff) >= a_entity_tngspt_staff_reqd)) THEN
         {
            a_entity_start_tng = clock(DAY)
            DEC v_num_RTOC_bays_avail, v_num_RTOC_bays
            INC v_num_total_entities_in_BCTC, 1
            INC v_num_corps_in_BCTC, 1
            INC v_num_corpsWFX_in_BCTC, 1
            INC v_num_JTX_in_BCTC, 1
            INC v_num_total_entities_in_BCTC, 1
            IF (v_num_divWFX_w_corpsWFX > 0) THEN
            {
               INC v_num_divWFX_in_BCTC, 1
               INC v_num_div_in_BCTC, 1
               INC v_num_total_entities_in_BCTC, 1
            }
            IF (v_num_bde_CPX_w_corpsWFX > 0) THEN
            {
               INC v_num_bde_CPX_in_BCTC, v_num_bde_CPX_w_corpsWFX
               INC v_num_total_entities_in_BCTC, v_num_bde_CPX_w_corpsWFX
            }

            // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
            ROUTE 3
         }
         ELSE
         {
            // move entity to loc_holding_area & WAIT 1 DAY
            ROUTE 2
         } // end else
```

```
      } //end else if bdes or bns in BCTC

      ELSE IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) AND ((FREEUNITS(r_simstim_staff) >=
a_entity_simstim_staff_reqd) AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND
(FREEUNITS(r_tngspt_staff) >= a_entity_tngspt_staff_reqd))THEN
      {
         a_entity_start_tng = clock(DAY)
         DEC v_num_RTOC_bays_avail, v_num_RTOC_bays
         INC v_num_total_entities_in_BCTC, 1
         INC v_num_corps_in_BCTC, 1
         INC v_num_corpsWFX_in_BCTC, 1
         INC v_num_JTX_in_BCTC, 1
         INC v_num_total_entities_in_BCTC, 1
         IF (v_num_divWFX_w_corpsWFX > 0) THEN
         {
            INC v_num_divWFX_in_BCTC, 1
            INC v_num_div_in_BCTC, 1
            INC v_num_total_entities_in_BCTC, 1
         }
         IF (v_num_bde_CPX_w_corpsWFX > 0) THEN
         {
            INC v_num_bde_CPX_in_BCTC, v_num_bde_CPX_w_corpsWFX
            INC v_num_total_entities_in_BCTC, v_num_bde_CPX_w_corpsWFX
         }

         // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
         ROUTE 3
      } // end ELSE IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) THEN

      ELSE
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      } // end else
   } // end if (a_entity_tng_type < 3)

   //check if corps CPX can enter
   ELSE IF (a_entity_tng_type = 3) THEN
   {
      //check if there are any corps, div, or JTX events in the BCTC
      IF (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0)  OR
```

```
(v_num_bde_CPX_in_BCTC > 0) OR (v_num_bn_CPX_in_BCTC > 0) THEN
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      }

      //check if there are any bde, bn, co, plt, or DI classroom training events going on in the BCTC
      ELSE IF (v_num_bde_DC_in_BCTC > 0) OR (v_num_bn_DC_in_BCTC > 0) OR (v_num_co_in_BCTC > 0) OR
(v_num_plt_in_BCTC > 0) OR (v_num_DI_in_BCTC > 0) THEN
      {
         IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) AND ((v_num_DC_tngdays_rem < arr_tng_duration[2, 1]) OR
(v_num_DI_tngdays_rem < arr_tng_duration[2, 1])) AND ((FREEUNITS(r_simstim_staff) >= a_entity_simstim_staff_reqd)
AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND (FREEUNITS(r_tngspt_staff) >=
a_entity_tngspt_staff_reqd)) THEN
         {
            a_entity_start_tng = clock(DAY)
            DEC v_num_RTOC_bays_avail, v_num_RTOC_bays
            INC v_num_total_entities_in_BCTC, 1
            INC v_num_corps_in_BCTC, 1
            INC v_num_corpsCPX_in_BCTC, 1
            // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
            ROUTE 3
         }
         ELSE
         {
            // move entity to loc_holding_area & WAIT 1 DAY
            ROUTE 2
         } // end else
      } //end else if bdes or bns in BCTC

      ELSE IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) AND ((FREEUNITS(r_simstim_staff) >=
a_entity_simstim_staff_reqd) AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND
(FREEUNITS(r_tngspt_staff) >= a_entity_tngspt_staff_reqd))THEN
      {
         a_entity_start_tng = clock(DAY)
         DEC v_num_RTOC_bays_avail, v_num_RTOC_bays
         INC v_num_total_entities_in_BCTC, 1
         INC v_num_corps_in_BCTC, 1
         INC v_num_corpsCPX_in_BCTC, 1
         // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
         ROUTE 3
```

```
      } // end ELSE IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) THEN

      ELSE
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      } // end else
   } // end if (a_entity_tng_type = 3
} // else end if (a_entity_type = 2)

//Can a Div entity enter the facility?

ELSE IF (a_entity_type = 3) THEN
{
   //check if the Div tng event is a WFX or JTX
   IF (a_entity_tng_type < 3) THEN
   {
      //check if there are any corps, div, or JTX events in the BCTC
      IF (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0) OR (v_num_bde_CPX_in_BCTC
> 0) OR (v_num_bn_CPX_in_BCTC > 0)   THEN
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      }

      //check if there are any bde, bn, co, plt, or DI classroom training events going on in the BCTC
      ELSE IF (v_num_bde_DC_in_BCTC > 0) OR (v_num_bn_DC_in_BCTC > 0) OR (v_num_co_in_BCTC > 0) OR
(v_num_plt_in_BCTC > 0) OR (v_num_DI_in_BCTC > 0) THEN
      {
         IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) AND ((v_num_DC_tngdays_rem < arr_tng_duration[1, 1]) OR
(v_num_DI_tngdays_rem < arr_tng_duration[1, 1])) AND ((FREEUNITS(r_simstim_staff) >= a_entity_simstim_staff_reqd)
AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND (FREEUNITS(r_tngspt_staff) >=
a_entity_tngspt_staff_reqd)) THEN
         {
            //for this entity, need to shut down location to any others for duration
            a_entity_start_tng = clock(DAY)
            DEC v_num_RTOC_bays_avail , (v_num_RTOC_bays)
            INC v_num_total_entities_in_BCTC, 1
            INC v_num_div_in_BCTC, 1
            INC v_num_divWFX_in_BCTC, 1
            IF (v_num_bde_CPX_w_divWFX > 0) THEN
```

```
            {
               INC v_num_bde_CPX_in_BCTC, v_num_bde_CPX_w_divWFX
               INC v_num_total_entities_in_BCTC, v_num_bde_CPX_w_divWFX
            }

            // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
            ROUTE 3
         }
         ELSE
         {
            // move entity to loc_holding_area & WAIT 1 DAY
            ROUTE 2
         } // end else
      } // end if v_num_bde_in_BCTC > 0) OR (v_num_bn_in_BCTC > 0)

      ELSE IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) AND ((FREEUNITS(r_simstim_staff) >=
a_entity_simstim_staff_reqd) AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND
(FREEUNITS(r_tngspt_staff) >= a_entity_tngspt_staff_reqd)) THEN
      {
         a_entity_start_tng = clock(DAY)
         DEC v_num_RTOC_bays_avail, v_num_RTOC_bays
         INC v_num_total_entities_in_BCTC, 1
         INC v_num_div_in_BCTC, 1
         INC v_num_divWFX_in_BCTC, 1
         IF (v_num_bde_CPX_w_divWFX > 0) THEN
         {
            INC v_num_bde_CPX_in_BCTC, v_num_bde_CPX_w_divWFX
            INC v_num_total_entities_in_BCTC, v_num_bde_CPX_w_divWFX
         }
         // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
         ROUTE 3
      } // end ELSE IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) THEN

      ELSE
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      } // end else
   } // end if (a_entity_tng_type < 3)

   // check if Div tng event is a CPX
```

```
   ELSE IF (a_entity_tng_type = 3) THEN
   {
      IF (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0) OR (v_num_bde_CPX_in_BCTC
> 0) OR (v_num_bn_CPX_in_BCTC > 0) THEN
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
       }

      //check if there are any bde, bn, co, plt, or DI classroom training events going on in the BCTC
      ELSE IF (v_num_bde_DC_in_BCTC > 0) OR (v_num_bn_DC_in_BCTC > 0) OR (v_num_co_in_BCTC > 0) OR
(v_num_plt_in_BCTC > 0) OR (v_num_DI_in_BCTC > 0) THEN
      {
         IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) AND ((v_num_DC_tngdays_rem < arr_tng_duration[2, 1]) OR
(v_num_DI_tngdays_rem < arr_tng_duration[2, 1])) AND ((FREEUNITS(r_simstim_staff) >= a_entity_simstim_staff_reqd)
AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND (FREEUNITS(r_tngspt_staff) >=
a_entity_tngspt_staff_reqd)) THEN
         {
            a_entity_start_tng = clock(DAY)
            DEC v_num_RTOC_bays_avail, (v_num_RTOC_bays)
            INC v_num_total_entities_in_BCTC, 1
            INC v_num_div_in_BCTC, 1
            INC v_num_divCPX_in_BCTC, 1
            // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
            ROUTE 3
         } // end if

         ELSE
         {
            // move entity to loc_holding_area & WAIT 1 DAY
            ROUTE 2
         } // end ELSE
      } // end ELSE IF (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0)

      ELSE IF (v_num_RTOC_bays_avail = v_num_RTOC_bays) AND ((FREEUNITS(r_simstim_staff) >=
a_entity_simstim_staff_reqd) AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND
(FREEUNITS(r_tngspt_staff) >= a_entity_tngspt_staff_reqd))THEN
      {
         a_entity_start_tng = clock(DAY)
         DEC v_num_RTOC_bays_avail, v_num_RTOC_bays
         INC v_num_total_entities_in_BCTC, 1
```

```
         INC v_num_div_in_BCTC, 1
         INC v_num_divCPX_in_BCTC, 1
         // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
         ROUTE 3
      } // end ELSE IF (v_num_RTOC_bays_avail = v_num_RTOC_bays)

      ELSE
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      } // end else
   } // end ELSE IF (a_entity_tng_type = 3)
} // end ELSE IF (a_entity_type = 3)

//Can a Bde entity enter the facility?
ELSE IF (a_entity_type = 4) THEN
{

   // check if training type is a BDE CPX
   IF (a_entity_tng_type = 3) THEN
   {
      a_entity_CT_staff_reqd = arr_staff[3,2]
      a_entity_simstim_staff_reqd = arr_staff[3,3]
      a_entity_techspt_staff_reqd = arr_staff[3,4]
      a_entity_tngspt_staff_reqd = arr_staff[3,5]
      a_entity_num_networks_reqd = arr_networks[2, 1]

      IF (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0) THEN
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      }//end if (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0)

      ELSE IF (v_num_RTOC_bays_avail >1) AND ((FREEUNITS(r_simstim_staff) >= a_entity_simstim_staff_reqd) AND
(FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND (FREEUNITS(r_tngspt_staff) >=
a_entity_tngspt_staff_reqd)) AND (FREEUNITS(r_networks) >= a_entity_num_networks_reqd) THEN
      {
         a_entity_start_tng = clock(DAY)
         DEC v_num_RTOC_bays_avail, 2
         INC v_num_total_entities_in_BCTC, 1
         INC v_num_bde_CPX_in_BCTC, 1
```

```
          INC v_num_bde_in_BCTC, 1
          // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
          ROUTE 3
       }
       ELSE
       {

          // move entity to loc_holding_area & WAIT 1 DAY
          ROUTE 2
       } // end IF (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0)
    } // end if (a_entity_tng_type = 3)

    //check if Bde is conducting CPX with Bns
    ELSE IF (a_entity_tng_type = 3.5) THEN
    {
       a_entity_CT_staff_reqd = (arr_staff[4,2] + a_num_bns_w_bde)
       a_entity_simstim_staff_reqd = (arr_staff[4,3] + a_num_bns_w_bde)
       a_entity_techspt_staff_reqd = (arr_staff[4,4] + a_num_bns_w_bde)
       a_entity_tngspt_staff_reqd = (arr_staff[4,5] + a_num_bns_w_bde)
       a_entity_num_networks_reqd = arr_networks[2, 1]

       IF (v_num_JTX_in_BCTC = 0) OR (v_num_corps_in_BCTC = 0) OR (v_num_div_in_BCTC = 0) THEN
       {
          IF (v_num_RTOC_bays_avail >= a_entity_RTOC_bays_reqd) AND ((FREEUNITS(r_simstim_staff) >=
a_entity_simstim_staff_reqd) AND (FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND
(FREEUNITS(r_tngspt_staff) >= a_entity_tngspt_staff_reqd)) AND (FREEUNITS(r_networks) >=
a_entity_num_networks_reqd) THEN
          {
//DISPLAY "Bde CPX w/ Bns is moving into the RTOC bays w/ " $a_num_bns_w_bde$ "bns"
//DISPLAY "# of RTOC Bays available: ", v_num_RTOC_bays_avail

             a_entity_start_tng = clock(DAY)
             INC v_num_total_entities_in_BCTC, (1 + a_num_bns_w_bde)
             INC v_num_bde_CPX_in_BCTC, 1
             INC v_num_bn_CPX_in_BCTC, (a_num_bns_w_bde)
             INC v_num_bde_in_BCTC, 1
             INC v_num_bn_in_BCTC, a_num_bns_w_bde
             DEC v_num_RTOC_bays_avail, (2 + a_num_bns_w_bde)
//DISPLAY "# of RTOC Bays available: ", v_num_RTOC_bays_avail
             ROUTE 3
          }//end if
```

```
         ELSE
         {
            //move entity to loc_holding_area and wait 1 day
            ROUTE 2
         } // end else
      }//end IF JTX, corps, or div in BCTC > 0

      ELSE
      {
         //move entity to loc_holding_area and wait 1 day
         ROUTE 2
      } // end else
   }//end else if entity training type = 3.5

   //asks if training type is a Bde-level daily collective event
   ELSE IF (a_entity_tng_type = 4) THEN
   {
      a_entity_IT_staff_reqd = arr_staff[2,1]
      a_entity_techspt_staff_reqd = arr_staff[2,4]
      a_entity_tngspt_staff_reqd = arr_staff[2,5]

      //Any corps or div WFXs or JTXs currently going on?
      IF (v_num_corpsWFX_in_BCTC > 0) OR (v_num_divWFX_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0) THEN
      {
         IF (v_num_corpsWFX_tngdays < arr_tng_duration[1, 1]) OR (v_num_divWFX_tngdays < arr_tng_duration[1, 1])
OR (v_num_JTX_tngdays < arr_tng_duration[1, 1]) THEN
         {
            IF (v_num_MPCR_avail > 0) AND (a_entity_tng_duration < v_num_rampup_days_rem) AND
(FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd)THEN
            {
               a_entity_start_tng = clock(DAY)
               DEC v_num_MPCR_avail, 1
               INC v_num_total_entities_in_BCTC, 1
               INC v_num_bde_DC_in_BCTC, 1
               INC v_num_bde_in_BCTC, 1
               // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY
               ROUTE 1
            }
            ELSE
            {
```

```
                // move entity to loc_holding_area & WAIT 1 DAY
                ROUTE 2
             } // end else
          } // end if Corps/Div WFX or JTX in ramp-up phase

          ELSE IF (v_num_corps_in_execution_phase > 0) OR (v_num_div_in_execution_phase > 0) OR
(v_num_JTX_in_execution_phase > 0) THEN
          {
             // move entity to loc_holding_area & WAIT 1 DAY
             ROUTE 2
          } // end else if corps, div, or JTX in execution

          ELSE IF (v_num_MPCR_avail > 0) AND (FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd) THEN
          {
             a_entity_start_tng = clock(DAY)
             DEC v_num_MPCR_avail, 1
             INC v_num_total_entities_in_BCTC, 1
             INC v_num_bde_DC_in_BCTC, 1
             INC v_num_bde_in_BCTC, 1
             // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY
             ROUTE 1
          } // end else if
          ELSE
          {
             // move entity to loc_holding_area & WAIT 1 DAY;
             ROUTE 2
          } // end else
       } //end check against Corps or Div WFXs and JTXs

       //Any Corps or Div CPXs going on?
       ELSE IF (v_num_corpsCPX_in_BCTC > 0) OR (v_num_divCPX_in_BCTC > 0) THEN
       {
          IF (v_num_corpsCPX_tngdays < arr_tng_duration[2,1]) OR (v_num_divCPX_tngdays < arr_tng_duration[2,1])
THEN
          {
             IF (v_num_MPCR_avail > 0) AND (a_entity_tng_duration < v_num_rampup_days_rem) AND
(FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd) THEN
             {
                a_entity_start_tng = clock(DAY)
                DEC v_num_MPCR_avail, 1
                INC v_num_total_entities_in_BCTC, 1
```

```
            INC v_num_bde_DC_in_BCTC, 1
            INC v_num_bde_in_BCTC, 1
            // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY
            ROUTE 1
         }
         ELSE
         {
            // move entity to loc_holding_area & WAIT 1 DAY
            ROUTE 2
         } // end else if
      } // end else if corps/div CPX in ramp-up

      ELSE IF (v_num_corps_in_execution_phase > 0) OR (v_num_div_in_execution_phase > 0) THEN
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      } // end else if corps/div CPX in execution

      ELSE IF (v_num_MPCR_avail > 0) AND (FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd) THEN
      {
         a_entity_start_tng = clock(DAY)
         DEC v_num_MPCR_avail, 1
         INC v_num_total_entities_in_BCTC, 1
         INC v_num_bde_DC_in_BCTC, 1
         INC v_num_bde_in_BCTC, 1
         // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY
         ROUTE 1
      } // end else if corps/div in recovery

      ELSE
      {
         // move entity to loc_holding_area & WAIT 1 DAY;
         ROUTE 2
      } // end else
   } //end check against Corps or Div CPXs

   ELSE IF (v_num_MPCR_avail > 0) AND (FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd) THEN
   {
      a_entity_start_tng = clock(DAY)
      DEC v_num_MPCR_avail, 1
      INC v_num_total_entities_in_BCTC, 1
```

```
          INC v_num_bde_DC_in_BCTC, 1
          INC v_num_bde_in_BCTC, 1
          // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY
          ROUTE 1
       }
       ELSE
       {
          // move entity to loc_holding_area & WAIT 1 DAY
          ROUTE 2
       } // end else
   } // end ELSE IF (a_entity_tng_type = 4)
} // end Bde entity entering the facility


// Can a Bn Entity enter the facility?
ELSE IF (a_entity_type = 5) THEN
{
   // check if training type is a BN CPX
   IF (a_entity_tng_type = 3) THEN
   {
      a_entity_CT_staff_reqd = arr_staff[3,2]
      a_entity_simstim_staff_reqd = arr_staff[3,3]
      a_entity_techspt_staff_reqd = arr_staff[3,4]
      a_entity_tngspt_staff_reqd = arr_staff[3,5]
      a_entity_num_networks_reqd = arr_networks[1, 1]
      IF (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0) THEN
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      }//end if (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0)

      ELSE IF (v_num_RTOC_bays_avail > 0) AND ((FREEUNITS(r_simstim_staff) >= a_entity_simstim_staff_reqd) AND
(FREEUNITS(r_techspt_staff) >= a_entity_techspt_staff_reqd) AND (FREEUNITS(r_tngspt_staff) >=
a_entity_tngspt_staff_reqd)) AND (FREEUNITS(r_networks) >= a_entity_num_networks_reqd) THEN
      {
         a_entity_start_tng = clock(DAY)
         DEC v_num_RTOC_bays_avail, 1
         INC v_num_total_entities_in_BCTC, 1
         INC v_num_bn_CPX_in_BCTC, 1
         INC v_num_bn_in_BCTC, 1
         // move entity to loc_RTOC_bays & WAIT (a_entity_tng_duration) DAY
```

```
          ROUTE 3
       }
       ELSE
       {
          // move entity to loc_holding_area & WAIT 1 DAY
          ROUTE 2
       } // end IF (v_num_corps_in_BCTC > 0) OR (v_num_div_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0)
    } // end if (a_entity_tng_type = 3)

    //asks if training type is a Bn-level daily collective event
    ELSE IF (a_entity_tng_type = 4) THEN
    {
       a_entity_IT_staff_reqd = arr_staff[2,1]
       a_entity_techspt_staff_reqd = arr_staff[2,4]
       a_entity_tngspt_staff_reqd = arr_staff[2,5]

       //Any corps or div WFXs or JTXs currently going on?
       IF (v_num_corpsWFX_in_BCTC > 0) OR (v_num_divWFX_in_BCTC > 0) OR (v_num_JTX_in_BCTC > 0) THEN
       {
          IF (v_num_corpsWFX_tngdays < arr_tng_duration[1, 1]) OR (v_num_divWFX_tngdays < arr_tng_duration[1, 1])
OR (v_num_JTX_tngdays < arr_tng_duration[1, 1]) THEN
          {
             IF (v_num_MPCR_avail > 0) AND (a_entity_tng_duration < v_num_rampup_days_rem) AND
(FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd) THEN
             {
                a_entity_start_tng = clock(DAY)
                DEC v_num_MPCR_avail, 1
                INC v_num_total_entities_in_BCTC, 1
                INC v_num_bn_DC_in_BCTC, 1
                INC v_num_bn_in_BCTC, 1
               // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY
                ROUTE 1
             }
             ELSE
             {
                // move entity to loc_holding_area & WAIT 1 DAY
                ROUTE 2
             } // end else
          } // end if corps/div WFX or JTX in ramp-up phase

          ELSE IF (v_num_corps_in_execution_phase > 0) OR (v_num_div_in_execution_phase > 0) OR
```

```
(v_num_JTX_in_execution_phase > 0) THEN
         {
            // move entity to loc_holding_area & WAIT 1 DAY
            ROUTE 2
         } // end else if corps/div/JTX in execution phase

         ELSE IF (v_num_MPCR_avail > 0) AND (FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd) THEN
         {
            a_entity_start_tng = clock(DAY)
            DEC v_num_MPCR_avail, 1
            INC v_num_total_entities_in_BCTC, 1
            INC v_num_bn_DC_in_BCTC, 1
            INC v_num_bn_in_BCTC, 1
            // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY
            ROUTE 1
         } // end else if

         ELSE
         {
            // move entity to loc_holding_area & WAIT 1 DAY;
            ROUTE 2
         } // end else
      } //end check against Corps or Div WFXs and JTXs

      //Any Corps or Div CPXs going on?
      ELSE IF (v_num_corpsCPX_in_BCTC > 0) OR (v_num_divCPX_in_BCTC > 0) THEN
      {
         IF (v_num_corpsCPX_tngdays < arr_tng_duration[2,1]) OR (v_num_divCPX_tngdays < arr_tng_duration[2,1])
THEN
         {
            IF (v_num_MPCR_avail > 0) AND (a_entity_tng_duration < v_num_rampup_days_rem) THEN
            {
               a_entity_start_tng = clock(DAY)
               DEC v_num_MPCR_avail, 1
               INC v_num_total_entities_in_BCTC, 1
               INC v_num_bn_DC_in_BCTC, 1
               INC v_num_bn_in_BCTC, 1
               // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY
               ROUTE 1
            }
            ELSE
```

```
          {
             // move entity to loc_holding_area & WAIT 1 DAY
             ROUTE 2
          } // end else if
       } // end else if corps/div CPX in ramp-up phase

       ELSE IF (v_num_corps_in_execution_phase > 0) OR (v_num_div_in_execution_phase > 0) THEN
       {
          // move entity to loc_holding_area & WAIT 1 DAY
          ROUTE 2
       } // end else if corps/div CPX in execution phase

       ELSE IF (v_num_MPCR_avail > 0) AND (FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd) THEN
       {
          a_entity_start_tng = clock(DAY)
          DEC v_num_MPCR_avail, 1
          INC v_num_total_entities_in_BCTC, 1
          INC v_num_bn_DC_in_BCTC, 1
          INC v_num_bn_in_BCTC, 1
          // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY
          ROUTE 1
       } // end else if (v_num_MPCR_avail > 0)

       ELSE
       {
          // move entity to loc_holding_area & WAIT 1 DAY;
          ROUTE 2
       } // end else
    } //end check against Corps or Div CPXs

    ELSE IF (v_num_MPCR_avail > 0) AND (FREEUNITS(r_IT_staff) >= a_entity_IT_staff_reqd) THEN
    {
       a_entity_start_tng = clock(DAY)
       DEC v_num_MPCR_avail, 1
       INC v_num_total_entities_in_BCTC, 1
       INC v_num_bn_DC_in_BCTC, 1
       INC v_num_bn_in_BCTC, 1
       // move entity to loc_MPCR & WAIT (a_entity_tng_duration) DAY
       ROUTE 1
    }
    ELSE
```

```
      {
         // move entity to loc_holding_area & WAIT 1 DAY
         ROUTE 2
      } // end else
   } // end ELSE IF (a_entity_tng_type = 4)
} // end bn entity entering the facility

// for a_entity_type values greater than 7 or less than 1
ELSE
{

   // move entity to a visitors area because I don't know what you are trying to do in my simulation
   ROUTE 4
} // end else catch all unknown entity types

//  END LOCATION RELEASE POINT...2
```

LOGIC FOR LOC_MPCR

ALL

```
//evaluate what happens if training type is individual level
IF (a_entity_type = 8) THEN
{
   a_entity_num_tngdays = 0

//DISPLAY "start DI training"
//DISPLAY a_entity_ref_num
   WHILE (a_entity_num_tngdays < a_entity_tng_duration) DO
   {
      USE a_entity_IT_staff_reqd r_IT_staff FOR 1 day
      INC a_entity_num_tngdays, 1
      a_entity_tngdays_rem = (a_entity_tng_duration - a_entity_num_tngdays)
      v_num_DI_tngdays_rem = a_entity_tngdays_rem
   }
   INC v_num_MPCR_avail, 1
   //move to exit
   ROUTE 1
//DISPLAY "end DI training"
} //end if training is individual level

//evaluate what happens if training type is daily collective
ELSE IF (a_entity_type < 8) THEN
{
   a_entity_num_tngdays = 0

   WHILE (a_entity_num_tngdays < a_entity_tng_duration) DO
   {
      USE a_entity_IT_staff_reqd r_IT_staff FOR 1 day
      INC a_entity_num_tngdays, 1
      a_entity_tngdays_rem = (a_entity_tng_duration - a_entity_num_tngdays)
      v_num_DC_tngdays_rem = a_entity_tngdays_rem
   }
   INC v_num_MPCR_avail, 1
   //move to exit
   ROUTE 1
} //end if training is daily collective
```

LOGIC FOR LOC_RTOC_BAYS	

ALL	//Check type of entity entering the RTOC Bays for training
	//Check the specific training type as necessary (for Corps - Bn)
	//Articulate the resource consumption
	//Increment and decrement appropriate variables
	//Specify where the entity goes next
	
	//Check if entity entering for training is a JTX
	IF (a_entity_type = 1) THEN
	{
	   v_num_JTX_tngdays = 0
	   a_entity_tng_phase = 1
	   v_num_JTX_in_rampup_phase = 1
	
	   WHILE (a_entity_tng_phase = 1) DO
	   {
	      USE a_entity_simstim_staff_reqd r_simstim_staff FOR 1 day AND a_entity_techspt_staff_reqd r_techspt_staff FOR 1 day AND a_entity_tngspt_staff_reqd r_tngspt_staff FOR 1 day AND a_entity_num_networks_reqd r_networks FOR 1 day
	      INC v_num_JTX_tngdays, 1
	      v_num_rampup_days_rem = (arr_tng_duration[1, 1] - v_num_JTX_tngdays)
	      IF (v_num_JTX_tngdays >= a_entity_tng_rampup_days) THEN
	      {
	         INC a_entity_tng_phase, 1
	         v_num_JTX_in_execution_phase = 1
	         DEC v_num_JTX_in_rampup_phase, 1
	      } //end if
	   } //end while
	
	   WHILE (a_entity_tng_phase = 2) DO
	   {
	      USE a_entity_CT_staff_reqd r_CT_staff FOR a_entity_tng_execution_days day AND a_entity_num_networks_reqd r_networks FOR a_entity_tng_execution_days day AND a_entity_simstim_staff_reqd r_simstim_staff FOR a_entity_tng_execution_days day AND a_entity_techspt_staff_reqd r_techspt_staff FOR a_entity_tng_execution_days day AND a_entity_tngspt_staff_reqd r_tngspt_staff FOR a_entity_tng_execution_days day
	      INC v_num_JTX_tngdays, a_entity_tng_execution_days
	      INC a_entity_tng_phase, 1
	      v_num_JTX_in_recovery_phase = 1

```
      DEC v_num_JTX_in_execution_phase, 1
   } //end while

   WHILE (a_entity_tng_phase = 3) DO
   {
      USE a_entity_simstim_staff_reqd r_simstim_staff FOR a_entity_tng_recovery_days day AND
a_entity_techspt_staff_reqd r_techspt_staff FOR a_entity_tng_recovery_days day AND a_entity_tngspt_staff_reqd
r_tngspt_staff FOR a_entity_tng_recovery_days day
      INC v_num_JTX_tngdays, a_entity_tng_recovery_days
      DEC v_num_JTX_in_recovery_phase, 1
      a_entity_tng_phase = 0
   } //end while

   // increment the number of bays available prior to entity departure & move to AAR
   v_num_JTX_tngdays = 0
   v_num_rampup_days_rem = 0
   INC v_num_RTOC_bays_avail, v_num_RTOC_bays
   ROUTE 2
} //end check if entity entering for training is a JTX

// Check if entity entering for training is a Corps
ELSE IF (a_entity_type = 2) THEN
{
   //Check Corps WFXs first
   IF (a_entity_tng_type = 2) THEN
   {
      v_num_corpsWFX_tngdays = 0
      a_entity_tng_phase = 1
      v_num_corpsWFX_in_rampup_phase = 1

      WHILE (a_entity_tng_phase = 1) DO
      {
         USE a_entity_simstim_staff_reqd r_simstim_staff FOR 1 day AND a_entity_techspt_staff_reqd
r_techspt_staff FOR 1 day AND a_entity_tngspt_staff_reqd r_tngspt_staff FOR 1 day AND
a_entity_num_networks_reqd r_networks FOR 1 day
         INC v_num_corpsWFX_tngdays, 1
         v_num_rampup_days_rem = (arr_tng_duration[1, 1] - v_num_corpsWFX_tngdays)
         IF (v_num_corpsWFX_tngdays >= a_entity_tng_rampup_days) THEN
         {
            INC a_entity_tng_phase, 1
            v_num_corpsWFX_in_execution_phase = 1
```

```
            DEC v_num_corpsWFX_in_rampup_phase, 1
         } //end if
      } //end while

      WHILE (a_entity_tng_phase = 2) DO
      {
         USE a_entity_CT_staff_reqd r_CT_staff FOR a_entity_tng_execution_days day AND
a_entity_num_networks_reqd r_networks FOR a_entity_tng_execution_days day AND a_entity_simstim_staff_reqd
r_simstim_staff FOR a_entity_tng_execution_days day AND a_entity_techspt_staff_reqd r_techspt_staff FOR
a_entity_tng_execution_days day AND a_entity_tngspt_staff_reqd r_tngspt_staff FOR a_entity_tng_execution_days
day
         INC v_num_corpsWFX_tngdays, a_entity_tng_execution_days
         INC a_entity_tng_phase, 1
         v_num_corpsWFX_in_recovery_phase = 1
         DEC v_num_corpsWFX_in_execution_phase, 1
      } //end while

      WHILE (a_entity_tng_phase = 3) DO
      {
         USE a_entity_simstim_staff_reqd r_simstim_staff FOR a_entity_tng_recovery_days day AND
a_entity_techspt_staff_reqd r_techspt_staff FOR a_entity_tng_recovery_days day AND a_entity_tngspt_staff_reqd
r_tngspt_staff FOR a_entity_tng_recovery_days day

         INC v_num_corpsWFX_tngdays, a_entity_tng_recovery_days
         DEC v_num_corpsWFX_in_recovery_phase, 1
         a_entity_tng_phase = 0
      } //end while
      // increment the number of bays available prior to entity departure & move to AAR
      v_num_corpsWFX_tngdays = 0
      v_num_rampup_days_rem = 0
      INC v_num_RTOC_bays_avail, v_num_RTOC_bays
      ROUTE 2
   } //end check if entity entering for training is a corpsWFX

   //Now check if Corps CPX
   ELSE IF (a_entity_tng_type = 3) THEN
   {
      v_num_corpsCPX_tngdays = 0
      a_entity_tng_phase = 1
      v_num_corpsCPX_in_rampup_phase = 1
```

```
      WHILE (a_entity_tng_phase = 1) DO
      {
         USE a_entity_simstim_staff_reqd r_simstim_staff FOR 1 day AND a_entity_techspt_staff_reqd
r_techspt_staff FOR 1 day AND a_entity_tngspt_staff_reqd r_tngspt_staff FOR 1 day AND
a_entity_num_networks_reqd r_networks FOR 1 day
         INC v_num_corpsCPX_tngdays, 1
         v_num_rampup_days_rem = (arr_tng_duration[1, 1] - v_num_corpsCPX_tngdays)
         IF (v_num_corpsCPX_tngdays >= a_entity_tng_rampup_days) THEN
         {
            INC a_entity_tng_phase, 1
            v_num_corpsCPX_in_execution_phase = 1
            DEC v_num_corpsCPX_in_rampup_phase, 1
         } //end if
      } //end while

      WHILE (a_entity_tng_phase = 2) DO
      {
         USE a_entity_CT_staff_reqd r_CT_staff FOR a_entity_tng_execution_days day AND
a_entity_num_networks_reqd r_networks FOR a_entity_tng_execution_days day AND a_entity_simstim_staff_reqd
r_simstim_staff FOR a_entity_tng_execution_days day AND a_entity_techspt_staff_reqd r_techspt_staff FOR
a_entity_tng_execution_days day AND a_entity_tngspt_staff_reqd r_tngspt_staff FOR a_entity_tng_execution_days
day
         INC v_num_corpsCPX_tngdays, a_entity_tng_execution_days
         INC a_entity_tng_phase, 1
         v_num_corpsCPX_in_recovery_phase = 1
         DEC v_num_corpsCPX_in_execution_phase, 1
      } //end while

      WHILE (a_entity_tng_phase = 3) DO
      {
         USE a_entity_simstim_staff_reqd r_simstim_staff FOR a_entity_tng_recovery_days day AND
a_entity_techspt_staff_reqd r_techspt_staff FOR a_entity_tng_recovery_days day AND a_entity_tngspt_staff_reqd
r_tngspt_staff FOR a_entity_tng_recovery_days day

         INC v_num_corpsCPX_tngdays, a_entity_tng_recovery_days
         DEC v_num_corpsCPX_in_recovery_phase, 1
         a_entity_tng_phase = 0
      } //end while

      // increment the number of bays available prior to entity departure & move to AAR
      v_num_corpsCPX_tngdays = 0
```

```
      v_num_rampup_days_rem = 0
      INC v_num_RTOC_bays_avail, v_num_RTOC_bays
      ROUTE 2
   } //end check if entity entering for training is a corpsCPX
}//end check if entity entering for training is a Corps

//Now check if entity entering for training is a division
ELSE IF (a_entity_type = 3) THEN
{
   //Check Div WFXs first
   IF (a_entity_tng_type = 2) THEN
   {
//DISPLAY "a Div WFX has entered the RTOC bays w/ ", v_num_bde_CPX_w_divWFX
      v_num_divWFX_tngdays = 0
      a_entity_tng_phase = 1
      v_num_divWFX_in_rampup_phase = 1
//DISPLAY "DIV WFX is now in ramp-up phase"
      WHILE (a_entity_tng_phase = 1) DO
      {
         USE a_entity_simstim_staff_reqd r_simstim_staff FOR 1 day AND a_entity_techspt_staff_reqd
r_techspt_staff FOR 1 day AND a_entity_tngspt_staff_reqd r_tngspt_staff FOR 1 day AND
a_entity_num_networks_reqd  r_networks FOR 1 day
         INC v_num_divWFX_tngdays, 1
         v_num_rampup_days_rem = (arr_tng_duration[1, 1] - v_num_divWFX_tngdays)
         IF (v_num_divWFX_tngdays >= a_entity_tng_rampup_days) THEN
         {
            INC a_entity_tng_phase, 1
            v_num_divWFX_in_execution_phase = 1
            DEC v_num_divWFX_in_rampup_phase, 1
         } //end if
      } //end while

//DISPLAY "ramp up phase complete"

      WHILE (a_entity_tng_phase = 2) DO
      {
//DISPLAY "DIV WFX is now in execution phase"

         USE a_entity_CT_staff_reqd r_CT_staff FOR a_entity_tng_execution_days day AND
a_entity_num_networks_reqd r_networks FOR a_entity_tng_execution_days day AND a_entity_simstim_staff_reqd
r_simstim_staff FOR a_entity_tng_execution_days day AND a_entity_techspt_staff_reqd r_techspt_staff FOR
```

```
a_entity_tng_execution_days day AND a_entity_tngspt_staff_reqd r_tngspt_staff FOR a_entity_tng_execution_days
day
         INC v_num_divWFX_tngdays, a_entity_tng_execution_days
         INC a_entity_tng_phase, 1
         v_num_divWFX_in_recovery_phase = 1
         DEC v_num_divWFX_in_execution_phase, 1
//DISPLAY "execution phase complete"
      } //end while

      WHILE (a_entity_tng_phase = 3) DO
      {
         USE a_entity_simstim_staff_reqd r_simstim_staff FOR a_entity_tng_recovery_days day AND
a_entity_techspt_staff_reqd r_techspt_staff FOR a_entity_tng_recovery_days day AND a_entity_tngspt_staff_reqd
r_tngspt_staff FOR a_entity_tng_recovery_days day

         INC v_num_divWFX_tngdays, a_entity_tng_recovery_days
         DEC v_num_divWFX_in_recovery_phase, 1
         a_entity_tng_phase = 0
      } //end while

      // increment the number of bays available prior to entity departure & move to AAR
      v_num_divWFX_tngdays = 0
      v_num_rampup_days_rem = 0
      INC v_num_RTOC_bays_avail, v_num_RTOC_bays
//DISPLAY "div WFX w/ "$v_num_bde_CPX_W_divWFX$" is complete"
      ROUTE 2
   } //end check if entity entering for training is a divWFX

   //Now check if Div CPX
   ELSE IF (a_entity_tng_type = 3) THEN
   {
      v_num_divCPX_tngdays = 0
      a_entity_tng_phase = 1
      v_num_divCPX_in_rampup_phase = 1

      WHILE (a_entity_tng_phase = 1) DO
      {
         USE a_entity_num_networks_reqd r_networks FOR 1 day AND a_entity_simstim_staff_reqd r_simstim_staff
FOR 1 day AND a_entity_techspt_staff_reqd r_techspt_staff FOR 1 day AND a_entity_tngspt_staff_reqd
r_tngspt_staff FOR 1 day
         INC v_num_divCPX_tngdays, 1
```

```
         v_num_rampup_days_rem = (arr_tng_duration[2, 1] - v_num_divCPX_tngdays)
         IF (v_num_divCPX_tngdays >= a_entity_tng_rampup_days) THEN
         {
            INC a_entity_tng_phase, 1
            v_num_divCPX_in_execution_phase = 1
            DEC v_num_divCPX_in_rampup_phase, 1
         } //end if
      } //end while

      WHILE (a_entity_tng_phase = 2) DO
      {
         USE a_entity_CT_staff_reqd r_CT_staff FOR a_entity_tng_execution_days day AND
a_entity_num_networks_reqd r_networks FOR a_entity_tng_execution_days day AND a_entity_simstim_staff_reqd
r_simstim_staff FOR a_entity_tng_execution_days day AND a_entity_techspt_staff_reqd r_techspt_staff FOR
a_entity_tng_execution_days day AND a_entity_tngspt_staff_reqd r_tngspt_staff FOR a_entity_tng_execution_days
day
         INC v_num_divCPX_tngdays, a_entity_tng_execution_days
         INC a_entity_tng_phase, 1
         v_num_divCPX_in_recovery_phase = 1
         DEC v_num_divCPX_in_execution_phase, 1
      } //end while

      WHILE (a_entity_tng_phase = 3) DO
      {
         USE a_entity_simstim_staff_reqd r_simstim_staff FOR a_entity_tng_recovery_days day AND
a_entity_techspt_staff_reqd r_techspt_staff FOR a_entity_tng_recovery_days day AND a_entity_tngspt_staff_reqd
r_tngspt_staff FOR a_entity_tng_recovery_days day

         INC v_num_divCPX_tngdays, a_entity_tng_recovery_days
         DEC v_num_divCPX_in_recovery_phase, 1
         a_entity_tng_phase = 0
      } //end while

      // increment the number of bays available prior to entity departure & move to AAR
     v_num_divCPX_tngdays = 0
     v_num_rampup_days_rem = 0
     INC v_num_RTOC_bays_avail, v_num_RTOC_bays
      ROUTE 2
   } //end check if entity entering for training is a divCPX
} //end check if entity entering for training is a Division
```

```
//Now check to see if entity entering for training is a bde
ELSE IF (a_entity_type = 4) THEN
{
   a_entity_num_tngdays = 0
   IF (a_entity_tng_type = 3) THEN
   {
//DISPLAY "a Bde has entered the RTOC bays and is using " $a_entity_RTOC_bays_reqd$ "for"
$a_entity_tng_duration$ "days"
//DISPLAY "the number of RTOC bays available is: ", v_num_RTOC_bays_avail

      USE a_entity_num_networks_reqd r_networks FOR a_entity_tng_duration day AND a_entity_CT_staff_reqd
r_CT_staff FOR (a_entity_tng_duration) day AND a_entity_simstim_staff_reqd r_simstim_staff FOR
(a_entity_tng_duration) day AND a_entity_techspt_staff_reqd r_techspt_staff FOR (a_entity_tng_duration) day AND
a_entity_tngspt_staff_reqd r_tngspt_staff FOR (a_entity_tng_duration) day
      // increment the number of bays available prior to entity departure & move to AAR room
      INC a_entity_num_tngdays, a_entity_tng_duration
      INC v_num_RTOC_bays_avail, 2
      ROUTE 1
//DISPLAY "Bde is leaving and is releasing " $a_entity_RTOC_bays_reqd$ "bays"
//DISPLAY "the number of RTOC bays available is: ", v_num_RTOC_bays_avail
   }//end if entity tng type = 3


   //check to see if tng type  is bde w/ bns)
   ELSE IF (a_entity_tng_type = 3.5) THEN
   {
//DISPLAY "bde w/ bns has entered RTOC bays and is occupying: " $(2 + a_num_bns_w_bde)$ "RTOC bays"
//DISPLAY "the number of RTOC bays available is: ", v_num_RTOC_bays_avail

//DISPLAY "the number of bns w/ bde is: ", a_num_bns_w_bde
      USE a_entity_num_networks_reqd r_networks FOR a_entity_tng_duration day AND a_entity_CT_staff_reqd
r_CT_staff FOR a_entity_tng_duration day AND a_entity_simstim_staff_reqd r_simstim_staff FOR
a_entity_tng_duration day AND a_entity_techspt_staff_reqd r_techspt_staff FOR a_entity_tng_duration day AND
a_entity_tngspt_staff_reqd r_tngspt_staff FOR a_entity_tng_duration day
      // increment the number of bays available prior to entity departure & move to AAR room
      INC a_entity_num_tngdays, a_entity_tng_duration
//DISPLAY "the number of bns w/ bde is: ", a_num_bns_w_bde

      INC v_num_RTOC_bays_avail, (2 + a_num_bns_w_bde)

//DISPLAY "bde w/ bns is leaving RTOC bays and is releasing" $(2 + a_num_bns_w_bde)$ " RTOC bays"
```

```
//DISPLAY "RTOC bays available is now: ", v_num_RTOC_bays_avail
      ROUTE 1
   }//end if entity tng type = 3.5
}// end else if entity type is a bde



//otherwise, check if entity is a bn
ELSE IF (a_entity_type = 5) THEN
{
   a_entity_num_tngdays = 0

//DISPLAY "start Bn CPX"
   IF (a_entity_tng_type = 3) THEN
   {
//DISPLAY "a Bn has entered the RTOC bays and is using " $a_entity_RTOC_bays_reqd$ "for"
$a_entity_tng_duration$ "days"
//DISPLAY "the number of RTOC bays available is: ", v_num_RTOC_bays_avail

      USE a_entity_num_networks_reqd r_networks FOR a_entity_tng_duration day AND a_entity_CT_staff_reqd
r_CT_staff FOR a_entity_tng_duration day AND a_entity_simstim_staff_reqd r_simstim_staff FOR
a_entity_tng_duration day AND a_entity_techspt_staff_reqd r_techspt_staff FOR a_entity_tng_duration day AND
a_entity_tngspt_staff_reqd r_tngspt_staff FOR a_entity_tng_duration day
      // increment the number of bays available prior to entity departure & move to AAR room
      INC a_entity_num_tngdays, a_entity_tng_duration
      INC v_num_RTOC_bays_avail, 1
      ROUTE 1

//DISPLAY "Bn is leaving and is releasing " $a_entity_RTOC_bays_reqd$ "bays"
//DISPLAY "the number of RTOC bays available is: ", v_num_RTOC_bays_avail
   }//end if entity tng type = 3

   //check to see if tng type = 3.5 (bn w/ bns)
   ELSE IF (a_entity_tng_type = 3.5) THEN
   {
//DISPLAY "bn w/ bns has entered RTOC bays and is occupying: " $(1 + a_num_bns_w_bde)$ "RTOC bays"
//DISPLAY "the number of RTOC bays available is: ", v_num_RTOC_bays_avail

//DISPLAY "the number of bns w/ bn is: ", a_num_bns_w_bn

      USE a_entity_num_networks_reqd r_networks FOR a_entity_tng_duration day AND a_entity_CT_staff_reqd
```

	r_CT_staff FOR a_entity_tng_duration day AND a_entity_simstim_staff_reqd r_simstim_staff FOR a_entity_tng_duration day AND a_entity_techspt_staff_reqd r_techspt_staff FOR a_entity_tng_duration day AND a_entity_tngspt_staff_reqd r_tngspt_staff FOR a_entity_tng_duration day
	      // increment the number of bays available prior to entity departure & move to AAR room
	      INC a_entity_num_tngdays, a_entity_tng_duration
	      INC v_num_RTOC_bays_avail, a_entity_RTOC_bays_reqd
	      ROUTE 1
	   }//end if entity tng type = 3.5
	}// end else if entity type is a bn
	
	//DISPLAY "end Bn CPX"

LOGIC FOR LOC_MPAAR

ALL

```
//How long does the entity remain at this location?

IF (a_entity_type < 4) THEN
{
   IF (a_entity_tng_type < 3) THEN
   {
      WAIT N((1/8),(1/48)) day
      //move to loc_exit
      ROUTE 1
   } // end if JTX or Corps/Div WFX

   ELSE IF (a_entity_tng_type = 3) THEN
   {
      WAIT N((1/12),(1/48)) day
      //move to loc_exit
      ROUTE 1
   }//end else if training type is Corps/Div CPX
}//end if entity type is JTX, Corps, or Div

ELSE IF (a_entity_type = 4) THEN
{
   IF (a_entity_tng_type = 3) THEN
   {
      WAIT N((1/16), (1/48)) day
      //move to loc_exit
      ROUTE 1
   }
   ELSE IF (a_entity_tng_type = 3.5) THEN
   {
      WAIT N((1/16), (1/48)) day
      //move to loc_exit
      UNLOAD (a_num_bns_w_bde)
      ROUTE 1
   }
}// end else if bde

ELSE IF (a_entity_type = 5) THEN
{
   IF (a_entity_tng_type = 3) THEN
   {
      WAIT N((1/16), (1/48)) day
      //move to loc_exit
      ROUTE 1
   }
   ELSE IF (a_entity_tng_type = 3.5) THEN
   {
      WAIT N((1/16), (1/48)) day
      //move to loc_exit
      UNGROUP
      ROUTE 1
   }
}//end else if bn
```

E_Bn_CPX

```
//How long does the entity remain at this location?
```

	``
	IF (a_entity_type < 4) THEN
	{
	   IF (a_entity_tng_type < 3) THEN
	   {
	      WAIT N((1/8),(1/48)) day
	      //move to loc_exit
	      ROUTE 1
	   } // end if JTX or Corps/Div WFX
	
	   ELSE IF (a_entity_tng_type = 3) THEN
	   {
	      WAIT N((1/12),(1/48)) day
	      //move to loc_exit
	      ROUTE 1
	   }//end else if training type is Corps/Div CPX
	}//end if entity type is JTX, Corps, or Div
	
	ELSE IF (a_entity_type = 4) THEN
	{
	   IF (a_entity_tng_type = 3) THEN
	   {
	      WAIT N((1/16), (1/48)) day
	      //move to loc_exit
	      ROUTE 1
	   }
	   ELSE IF (a_entity_tng_type = 3.5) THEN
	   {
	      WAIT N((1/16), (1/48)) day
	      //move to loc_exit
	      UNLOAD (a_num_bns_w_bde)
	      ROUTE 1
	   }
	}// end else if bde
	
	ELSE IF (a_entity_type = 5) THEN
	{
	   IF (a_entity_tng_type = 3) THEN
	   {
	      WAIT N((1/16), (1/48)) day
	      //move to loc_exit
	      ROUTE 1
	   }
	   ELSE IF (a_entity_tng_type = 3.5) THEN
	   {
	      WAIT N((1/16), (1/48)) day
	      //move to loc_exit
	      UNGROUP
	      ROUTE 1
	   }
	}//end else if bn
	``

LOGIC FOR LOC_EXIT

ALL

```
//track the total # of entities that leave the BCTC

DEC v_num_total_entities_in_BCTC, 1
INC v_num_total_entities_end, 1

//Account for JTXs that exit
IF (a_entity_type = 1) THEN
{
   DEC v_num_JTX_in_BCTC, 1
   IF (v_num_corpsWFX_w_JTX > 0) THEN
   {
      DEC v_num_corpsWFX_w_JTX, 1
      DEC v_num_corps_in_BCTC, 1
      DEC v_num_total_entities_in_BCTC, 1
      DEC v_num_corpsWFX_in_BCTC, 1
      INC v_num_corpsWFX_end, 1
      INC v_num_corps_end, 1
      INC v_num_total_entities_end, 1
   }
   IF (v_num_divWFX_w_JTX > 0) THEN
   {
      DEC v_num_divWFX_w_JTX, 1
      DEC v_num_div_in_BCTC, 1
      DEC v_num_total_entities_in_BCTC, 1
      DEC v_num_divWFX_in_BCTC, 1
      INC v_num_divWFX_end, 1
      INC v_num_div_end, 1
      INC v_num_total_entities_end, 1
   }
   IF (v_num_bde_CPX_w_JTX > 0) THEN
   {
      DEC v_num_bde_CPX_in_BCTC, v_num_bde_CPX_w_JTX
      DEC v_num_total_entities_in_BCTC, v_num_bde_CPX_w_JTX
      INC v_num_bde_CPX_end, v_num_bde_CPX_w_JTX
      INC v_num_total_entities_end, v_num_bde_CPX_w_JTX
   }
   INC v_num_JTX_end, 1
   ROUTE 1
} //end Account number JTXs that exit

//Account for number of corps that exit and by type of event
ELSE IF (a_entity_type = 2) THEN
{
   //account for corps WFXs
   IF (a_entity_tng_type = 2) THEN
   {
      DEC v_num_corps_in_BCTC, 1
      DEC v_num_corpsWFX_in_BCTC, 1
      DEC v_num_JTX_in_BCTC, 1
      DEC v_num_total_entities_in_BCTC, 1
      INC v_num_corps_end, 1
      INC v_num_corpsWFX_end, 1
      INC v_num_JTX_end, 1
```

```
      INC v_num_total_entities_end, 1
      IF (v_num_divWFX_w_corpsWFX > 0) THEN
      {
         DEC v_num_divWFX_w_corpsWFX, 1
         DEC v_num_div_in_BCTC, 1
         DEC v_num_total_entities_in_BCTC, 1
         DEC v_num_divWFX_in_BCTC, 1
         INC v_num_divWFX_end, 1
         INC v_num_div_end, 1
         INC v_num_total_entities_end, 1
      }
      IF (v_num_bde_CPX_w_corpsWFX > 0) THEN
      {
         DEC v_num_bde_CPX_in_BCTC, v_num_bde_CPX_w_corpsWFX
         DEC v_num_total_entities_in_BCTC, v_num_bde_CPX_w_corpsWFX
         INC v_num_bde_CPX_end, v_num_bde_CPX_w_corpsWFX
         INC v_num_total_entities_end, v_num_bde_CPX_w_corpsWFX
      }
      ROUTE 1
   } // end corps WFXs

   //account for corps CPXs
   ELSE IF (a_entity_tng_type = 3) THEN
   {
      DEC v_num_corps_in_BCTC, 1
      DEC v_num_corpsCPX_in_BCTC, 1
      INC v_num_corps_end, 1
      INC v_num_corpsCPX_end, 1
      ROUTE 1
   } //end div CPXs
} //end account for div that exit

//Account for number of Divs that exit and by type of event
ELSE IF (a_entity_type = 3) THEN
{
   //account for Div WFXs
   IF (a_entity_tng_type = 2) THEN
   {
//DEBUG
      DEC v_num_div_in_BCTC, 1
      DEC v_num_divWFX_in_BCTC, 1
      INC v_num_div_end, 1
      INC v_num_divWFX_end, 1
      IF (v_num_bde_CPX_w_divWFX > 0) THEN
      {
         DEC v_num_bde_CPX_in_BCTC, v_num_bde_CPX_w_divWFX
         DEC v_num_total_entities_in_BCTC, v_num_bde_CPX_w_divWFX
         INC v_num_bde_CPX_end, v_num_bde_CPX_w_divWFX
         INC v_num_total_entities_end, v_num_bde_CPX_w_divWFX
      }
      ROUTE 1
   } //end div WFXs

   //account for Div CPXs
   ELSE IF (a_entity_tng_type = 3) THEN
   {
      DEC v_num_div_in_BCTC, 1
```

```
      DEC v_num_divCPX_in_BCTC, 1
      INC v_num_div_end, 1
      INC v_num_divCPX_end, 1
      ROUTE 1
   } //end div CPXs
} //end account for number of Divs that exit

//Account number BDEs that exit
ELSE IF (a_entity_type = 4) THEN
{
   IF (a_entity_tng_type = 3) THEN
   {
//DEBUG
      DEC v_num_bde_in_BCTC, 1
      DEC v_num_bde_CPX_in_BCTC, 1
      INC v_num_bde_CPX_end, 1
      ROUTE 1
   } //end Account number BDEs that exit
   ELSE IF (a_entity_tng_type = 3.5) THEN
   {
      DEC v_num_bde_in_BCTC, 1
      DEC v_num_bde_CPX_in_BCTC, 1
      INC v_num_bde_CPX_end, 1
      ROUTE 1
   } //end Account number BDEs that exit
   ELSE IF (a_entity_tng_type = 4) THEN
   {
      DEC v_num_bde_in_BCTC, 1
      DEC v_num_bde_DC_in_BCTC, 1
      INC v_num_bde_DC_end, 1
      ROUTE 1
   }
}//end Account number BDEs that exit

//Account number BNs that exit
ELSE IF (a_entity_type = 5) THEN
{
   IF (a_entity_tng_type = 3) THEN
   {
      DEC v_num_bn_in_BCTC, 1
      DEC v_num_bn_CPX_in_BCTC, 1
      INC v_num_bn_CPX_end, 1
      ROUTE 1
   } //end Account number Bns that exit
   ELSE IF (a_entity_tng_type = 3.5) THEN
   {
      DEC v_num_bn_in_BCTC, 1
      DEC v_num_bn_CPX_in_BCTC, 1
      INC v_num_bn_CPX_end, 1
      ROUTE 1
   } //end Account number BDEs that exit
   ELSE IF (a_entity_tng_type = 4) THEN
   {
      DEC v_num_bn_in_BCTC, 1
      DEC v_num_bn_DC_in_BCTC, 1
      INC v_num_bn_DC_end, 1
      ROUTE 1
```

	``
	   }
	} //end Account number BNs that exit
	
	//Account number COs that exit
	ELSE IF (a_entity_type = 6) THEN
	{
	   DEC v_num_co_in_BCTC, 1
	   INC v_num_co_end, 1
	   ROUTE 1
	} //end Account number COs that exit
	
	//Account number PLTs that exit
	ELSE IF (a_entity_type = 7) THEN
	{
	   DEC v_num_plt_in_BCTC, 1
	   INC v_num_plt_end, 1
	   ROUTE 1
	} //end Account number PLTs that exit
	
	//Account for number of daily individual events that exit
	ELSE IF (a_entity_type = 8) THEN
	{
	   DEC v_num_DI_in_BCTC, 1
	   INC v_num_DI_end, 1
	   ROUTE 1
	} //end Account for number of daily individual events that exit
	``

Appendix L: Optimization Output – Large BCTC

Large BCTC Optimization Results (from CAUTIOUS Profile Experiment)

					Response Statistics (variables)								Input Factors (Macros)								Confidence Intervals	
	Experiment	Obj Fcn	# days	# enitites	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	LOW	HIGH
1	240	-69.8	224.567	665.5	6	10	15	17	7	6	7	5	6	10	15	17	7	6	7	5	-70.835	-68.765
2	192	-70.8	224.567	665.5	6	10	15	17	7	6	8	5	6	10	15	17	7	6	8	5	-71.835	-69.765
3	191	-70.8	224.567	665.5	7	10	16	17	7	6	7	6	6	10	15	17	7	6	7	6	-71.835	-69.765
4	242	-70.8	224.567	665.5	6	10	15	17	7	7	7	5	6	10	15	17	7	7	7	5	-71.835	-69.765
5	260	-70.8	224.567	665.5	6	10	15	18	7	6	7	5	6	10	15	18	7	6	7	5	-71.835	-69.765
6	46	-70.933	223.5	665.367	6	11	15	17	8	6	7	5	6	10	15	17	8	6	7	5	-72.06	-69.807
7	235	-71.8	224.567	665.5	7	10	17	17	7	6	8	6	6	10	15	17	7	6	8	6	-72.835	-70.765
8	239	-71.8	224.567	665.5	6	10	15	17	7	7	7	6	6	10	15	17	7	7	7	6	-72.835	-70.765
9	193	-71.8	224.567	665.5	6	10	15	17	7	7	8	5	6	10	15	17	7	7	8	5	-72.835	-70.765
10	194	-71.8	224.567	665.5	6	10	15	18	7	6	8	5	6	10	15	18	7	6	8	5	-72.835	-70.765
	AVERAGE VALUES:		**224.46**	**665.49**	**6.2**	**10.1**	**15.3**	**17.2**	**7.1**	**6.3**	**7.4**	**5.3**										
			225	**666**	**7**	**11**	**16**	**18**	**8**	**7**	**8**	**6**										
11	250	-71.8	224.567	665.5	6	11	15	17	7	6	8	5	6	11	15	17	7	6	8	5	-72.835	-70.765
12	252	-71.8	224.567	665.5	6	10	16	17	7	6	8	5	6	10	16	17	7	6	8	5	-72.835	-70.765
13	254	-71.8	224.567	665.5	6	11	15	17	7	6	7	6	6	11	15	17	7	6	7	6	-72.835	-70.765
14	206	-71.8	224.567	665.5	6	10	16	17	7	7	7	5	6	10	16	17	7	7	7	5	-72.835	-70.765
15	215	-71.933	223.5	665.367	6	10	15	18	8	6	7	5	6	10	15	18	8	6	7	5	-73.06	-70.807
16	248	-71.933	223.5	665.367	6	10	15	17	8	7	7	5	6	10	15	17	8	7	7	5	-73.06	-70.807
17	44	-71.933	223.5	665.367	6	11	15	17	8	6	7	5	6	11	15	17	8	6	7	5	-73.06	-70.807
18	39	-71.933	223.5	665.367	6	10	15	17	8	6	7	6	6	10	15	17	8	6	7	6	-73.06	-70.807
19	47	-71.933	223.5	665.367	6	10	15	17	8	6	8	5	6	10	15	17	8	6	8	5	-73.06	-70.807
20	241	-71.933	223.5	665.367	6	10	16	17	8	6	7	5	6	10	16	17	8	6	7	5	-73.06	-70.807
21	130	-72.8	224.567	665.5	6	11	15	17	7	7	7	6	6	11	15	17	7	7	7	6	-73.835	-71.765
22	160	-72.8	224.567	665.5	6	10	15	18	7	6	8	6	6	10	15	18	7	6	8	6	-73.835	-71.765
23	161	-72.8	224.567	665.5	6	11	15	17	7	6	8	6	6	11	15	17	7	6	8	6	-73.835	-71.765
24	205	-72.8	224.567	665.5	6	10	15	20	7	6	7	5	6	10	15	20	7	6	7	5	-73.835	-71.765
25	243	-72.8	224.567	665.5	6	10	15	17	7	6	9	6	6	10	15	17	7	6	9	6	-73.835	-71.765
26	247	-72.8	224.567	665.5	6	10	15	18	7	7	8	5	6	10	15	18	7	7	8	5	-73.835	-71.765
27	181	-72.8	224.567	665.5	6	11	15	17	7	7	8	5	6	11	15	17	7	7	8	5	-73.835	-71.765
28	249	-72.8	224.567	665.5	6	11	15	18	7	6	8	5	6	11	15	18	7	6	8	5	-73.835	-71.765
29	189	-72.8	224.567	665.5	6	10	16	18	7	6	8	5	6	10	16	18	7	6	8	5	-73.835	-71.765
30	219	-72.8	224.567	665.5	6	10	16	17	7	6	9	5	6	10	16	17	7	6	9	5	-73.835	-71.765
31	253	-72.8	224.567	665.5	6	10	16	17	7	7	8	5	6	10	16	17	7	7	8	5	-73.835	-71.765
32	229	-72.8	224.567	665.5	6	11	15	17	7	6	9	5	6	11	15	17	7	6	9	5	-73.835	-71.765
33	255	-72.8	224.567	665.5	6	10	15	17	7	7	8	6	6	10	15	17	7	7	8	6	-73.835	-71.765
34	98	-72.8	224.567	665.5	6	10	15	17	7	8	8	5	6	10	15	17	7	8	8	5	-73.835	-71.765
35	35	-72.933	223.5	665.367	6	10	15	17	8	6	8	6	6	10	15	17	8	6	8	6	-74.06	-71.807
36	237	-72.933	223.5	665.367	6	11	15	17	8	7	7	5	6	11	15	17	8	7	7	5	-74.06	-71.807
37	246	-72.933	223.5	665.367	6	10	15	17	8	7	8	5	6	10	15	17	8	7	8	5	-74.06	-71.807
38	167	-72.933	223.5	665.367	6	10	15	18	8	7	7	5	6	10	15	18	8	7	7	5	-74.06	-71.807
39	200	-72.933	223.5	665.367	6	10	15	17	8	6	9	5	6	10	15	17	8	6	9	5	-74.06	-71.807
40	258	-72.933	223.5	665.367	6	10	15	17	8	7	7	6	6	10	15	17	8	7	7	6	-74.06	-71.807
41	38	-72.933	223.5	665.367	6	11	15	17	8	6	7	6	6	11	15	17	8	6	7	6	-74.06	-71.807
42	173	-73.8	224.567	665.5	6	10	17	19	7	6	7	5	6	10	17	19	7	6	7	5	-74.835	-72.765
43	175	-73.8	224.567	665.5	6	10	16	18	7	6	8	6	6	10	16	18	7	6	8	6	-74.835	-72.765
44	30	-73.8	224.567	665.5	6	11	15	17	7	6	9	6	6	11	15	17	7	6	9	6	-74.835	-72.765
45	245	-73.8	224.567	665.5	6	11	15	18	7	6	8	6	6	11	15	18	7	6	8	6	-74.835	-72.765
46	221	-73.8	224.567	665.5	6	10	15	19	7	6	8	6	6	10	15	19	7	6	8	6	-74.835	-72.765
47	225	-73.8	224.567	665.5	6	10	17	18	7	6	8	5	6	10	17	18	7	6	8	5	-74.835	-72.765
48	226	-73.8	224.567	665.5	6	11	15	17	7	8	7	6	6	11	15	17	7	8	7	6	-74.835	-72.765
49	227	-73.8	224.567	665.5	6	10	15	18	7	7	9	5	6	10	15	18	7	7	9	5	-74.835	-72.765

Training Staff	LWN Cisco Optr	Tacsim Spt (SCIF)	Hub Support Staff	Mgmt Staff	Turbulence	TOTAL
57	**3**	**6**	**12**	**13**	**10%**	**100.1**

					Response Statistics (variables)								Input Factors (Macros)								Confidence Intervals	
	Experiment	Obj Fcn	# days	# enitites	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	LOW	HIGH
50	185	-73.8	224.567	665.5	6	10	15	17	7	8	9	5	6	10	15	17	7	8	9	5	-74.835	-72.765
51	251	-73.8	224.567	665.5	6	10	16	18	7	7	8	5	6	10	16	18	7	7	8	5	-74.835	-72.765
52	230	-73.8	224.567	665.5	6	10	17	17	7	6	9	5	6	10	17	17	7	6	9	5	-74.835	-72.765
53	233	-73.8	224.567	665.5	6	10	16	19	7	6	8	5	6	10	16	19	7	6	8	5	-74.835	-72.765
54	187	-73.8	224.567	665.5	6	10	15	20	7	6	7	6	6	10	15	20	7	6	7	6	-74.835	-72.765
55	201	-73.8	224.567	665.5	6	11	15	19	7	7	7	5	6	11	15	19	7	7	7	5	-74.835	-72.765
56	256	-73.8	224.567	665.5	6	11	16	18	7	6	7	6	6	11	16	18	7	6	7	6	-74.835	-72.765
57	203	-73.8	224.567	665.5	6	10	15	18	7	6	9	6	6	10	15	18	7	6	9	6	-74.835	-72.765
58	259	-73.8	224.567	665.5	6	11	15	18	7	7	7	6	6	11	15	18	7	7	7	6	-74.835	-72.765
59	172	-73.8	224.567	665.5	6	11	15	17	7	7	8	6	6	11	15	17	7	7	8	6	-74.835	-72.765
60	244	-73.933	223.5	665.367	6	11	15	17	8	7	7	6	6	11	15	17	8	7	7	6	-75.06	-72.807
61	178	-73.933	223.5	665.367	6	10	15	20	8	6	7	5	6	10	15	20	8	6	7	5	-75.06	-72.807
62	238	-73.933	223.5	665.367	6	10	15	17	8	8	8	5	6	10	15	17	8	8	8	5	-75.06	-72.807
63	15	-73.933	223.5	665.367	6	11	15	17	8	6	8	6	6	11	15	17	8	6	8	6	-75.06	-72.807
64	45	-73.933	223.5	665.367	6	10	15	19	8	6	7	6	6	10	15	19	8	6	7	6	-75.06	-72.807
65	48	-73.933	223.5	665.367	6	11	15	17	8	8	7	5	6	11	15	17	8	8	7	5	-75.06	-72.807
66	34	-73.933	223.5	665.367	6	11	15	17	8	6	9	5	6	11	15	17	8	6	9	5	-75.06	-72.807
67	43	-73.933	223.5	665.367	6	10	15	17	8	6	9	6	6	10	15	17	8	6	9	6	-75.06	-72.807
68	41	-73.967	223.6	665.367	6	10	15	17	9	6	8	6	6	10	15	17	9	6	8	6	-75.095	-72.838
69	49	-73.967	223.6	665.367	6	11	15	17	9	6	7	6	6	11	15	17	9	6	7	6	-75.095	-72.838
70	168	-74.3	215.2	665.5	7	10	15	17	7	6	8	5	7	10	15	17	7	6	8	5	-74.959	-73.641
71	216	-74.333	216.433	665.367	7	10	15	17	8	6	7	5	7	10	15	17	8	6	7	5	-75.001	-73.666
72	207	-74.8	224.567	665.5	6	10	15	18	7	8	8	6	6	10	15	18	7	8	8	6	-75.835	-73.765
73	208	-74.8	224.567	665.5	6	11	15	17	7	8	8	6	6	11	15	17	7	8	8	6	-75.835	-73.765
74	210	-74.8	224.567	665.5	6	10	15	19	7	7	9	5	6	10	15	19	7	7	9	5	-75.835	-73.765
75	211	-74.8	224.567	665.5	6	11	15	18	7	6	9	6	6	11	15	18	7	6	9	6	-75.835	-73.765
76	184	-74.8	224.567	665.5	6	10	15	19	7	8	8	5	6	10	15	19	7	8	8	5	-75.835	-73.765
77	36	-74.8	224.567	665.5	6	11	15	19	7	6	8	6	6	11	15	19	7	6	8	6	-75.835	-73.765
78	196	-74.8	224.567	665.5	6	10	15	19	7	7	8	6	6	10	15	19	7	7	8	6	-75.835	-73.765
79	220	-74.8	224.567	665.5	6	10	15	20	7	6	8	6	6	10	15	20	7	6	8	6	-75.835	-73.765
80	50	-74.8	224.567	665.5	6	10	16	18	7	7	8	6	6	10	16	18	7	7	8	6	-75.835	-73.765
81	188	-74.8	224.567	665.5	6	10	15	19	7	6	9	6	6	10	15	19	7	6	9	6	-75.835	-73.765
82	62	-74.8	224.567	665.5	6	10	16	20	7	6	8	5	6	10	16	20	7	6	8	5	-75.835	-73.765
83	28	-74.8	224.567	665.5	6	11	15	17	7	7	9	6	6	11	15	17	7	7	9	6	-75.835	-73.765
84	65	-74.8	224.567	665.5	6	10	17	19	7	6	8	5	6	10	17	19	7	6	8	5	-75.835	-73.765
85	13	-74.933	223.5	665.367	6	11	15	17	8	7	9	5	6	11	15	17	8	7	9	5	-76.06	-73.807
86	218	-74.933	223.5	665.367	6	10	15	18	8	8	7	6	6	10	15	18	8	8	7	6	-76.06	-73.807
87	182	-74.933	223.5	665.367	6	10	15	18	8	7	8	6	6	10	15	18	8	7	8	6	-76.06	-73.807
88	190	-74.933	223.5	665.367	6	10	15	18	8	7	9	5	6	10	15	18	8	7	9	5	-76.06	-73.807
89	257	-74.933	223.5	665.367	6	10	17	18	8	6	8	5	6	10	17	18	8	6	8	5	-76.06	-73.807
90	12	-74.933	223.5	665.367	6	10	15	17	8	8	8	6	6	10	15	17	8	8	8	6	-76.06	-73.807
91	177	-74.933	223.5	665.367	6	11	15	20	8	6	7	5	6	11	15	20	8	6	7	5	-76.06	-73.807
92	31	-74.933	223.5	665.367	6	11	15	17	8	7	8	6	6	11	15	17	8	7	8	6	-76.06	-73.807
93	195	-74.967	223.6	665.367	6	10	15	19	9	6	8	5	6	10	15	19	9	6	8	5	-76.095	-73.838
94	174	-75.3	215.2	665.5	7	10	15	19	7	6	7	5	7	10	15	19	7	6	7	5	-75.959	-74.641
95	223	-75.3	215.2	665.5	7	10	15	17	7	6	8	6	7	10	15	17	7	6	8	6	-75.959	-74.641
96	197	-75.3	215.2	665.5	7	10	15	17	7	6	9	5	7	10	15	17	7	6	9	5	-75.959	-74.641
97	66	-75.333	216.433	665.367	7	10	15	18	8	6	7	5	7	10	15	18	8	6	7	5	-76.001	-74.666
98	166	-75.8	224.567	665.5	6	11	15	19	7	8	8	5	6	11	15	19	7	8	8	5	-76.835	-74.765
99	234	-75.8	224.567	665.5	6	10	16	18	7	7	9	6	6	10	16	18	7	7	9	6	-76.835	-74.765
100	209	-75.8	224.567	665.5	6	10	16	18	7	8	8	6	6	10	16	18	7	8	8	6	-76.835	-74.765
101	72	-75.8	224.567	665.5	6	11	16	20	7	7	7	5	6	11	16	20	7	7	7	5	-76.835	-74.765
102	26	-75.8	224.567	665.5	6	11	15	19	7	6	9	6	6	11	15	19	7	6	9	6	-76.835	-74.765
103	170	-75.8	224.567	665.5	6	10	17	19	7	6	8	6	6	10	17	19	7	6	8	6	-76.835	-74.765
104	162	-75.8	224.567	665.5	6	10	15	20	7	8	8	5	6	10	15	20	7	8	8	5	-76.835	-74.765
105	179	-75.8	224.567	665.5	6	10	15	19	7	8	8	6	6	10	15	19	7	8	8	6	-76.835	-74.765
106	180	-75.8	224.567	665.5	6	10	16	20	7	7	7	6	6	10	16	20	7	7	7	6	-76.835	-74.765

					Response Statistics (variables)								Input Factors (Macros)								Confidence Intervals	
	Experiment	Obj Fcn	# days	# enitites	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	LOW	HIGH
107	2	-75.933	223.5	665.367	6	11	15	19	8	6	8	6	6	11	15	19	8	6	8	6	-77.06	-74.807
108	40	-75.933	223.5	665.367	6	11	18	17	8	6	7	6	6	11	18	17	8	6	7	6	-77.06	-74.807
109	37	-75.933	223.5	665.367	6	10	15	17	8	8	9	6	6	10	15	17	8	8	9	6	-77.06	-74.807
110	76	-75.933	223.5	665.367	6	10	15	19	8	7	9	5	6	10	15	19	8	7	9	5	-77.06	-74.807
111	164	-75.933	223.5	665.367	6	10	18	18	8	6	8	5	6	10	18	18	8	6	8	5	-77.06	-74.807
112	33	-75.933	223.5	665.367	6	11	15	17	8	8	8	6	6	11	15	17	8	8	8	6	-77.06	-74.807
113	228	-75.933	223.5	665.367	6	10	15	18	8	8	9	5	6	10	15	18	8	8	9	5	-77.06	-74.807
114	176	-75.933	223.5	665.367	6	11	15	18	8	6	9	6	6	11	15	18	8	6	9	6	-77.06	-74.807
115	108	-75.933	223.5	665.367	6	10	15	18	8	8	8	6	6	10	15	18	8	8	8	6	-77.06	-74.807
116	136	-75.967	223.6	665.367	6	10	15	19	9	6	8	6	6	10	15	19	9	6	8	6	-77.095	-74.838
117	217	-75.967	223.6	665.367	6	10	16	20	9	6	7	5	6	10	16	20	9	6	7	5	-77.095	-74.838
118	145	-75.967	223.6	665.367	6	10	17	18	9	6	8	5	6	10	17	18	9	6	8	5	-77.095	-74.838
119	165	-75.967	223.6	665.367	6	11	15	17	9	6	9	6	6	11	15	17	9	6	9	6	-77.095	-74.838
120	64	-76.3	215.2	665.5	7	10	15	20	7	6	7	5	7	10	15	20	7	6	7	5	-76.959	-75.641
121	183	-76.3	215.2	665.5	7	10	15	17	7	8	8	5	7	10	15	17	7	8	8	5	-76.959	-75.641
122	124	-76.3	215.2	665.5	7	10	15	17	7	6	9	6	7	10	15	17	7	6	9	6	-76.959	-75.641
123	186	-76.333	216.433	665.367	7	10	15	18	8	6	8	5	7	10	15	18	8	6	8	5	-77.001	-75.666
124	29	-76.8	224.567	665.5	6	11	17	19	7	6	9	5	6	11	17	19	7	6	9	5	-77.835	-75.765
125	55	-76.8	224.567	665.5	6	11	15	19	7	8	8	6	6	11	15	19	7	8	8	6	-77.835	-75.765
126	199	-76.8	224.567	665.5	6	10	16	20	7	7	8	6	6	10	16	20	7	7	8	6	-77.835	-75.765
127	236	-76.8	224.567	665.5	6	11	17	19	7	7	8	5	6	11	17	19	7	7	8	5	-77.835	-75.765
128	212	-76.8	224.567	665.5	6	10	16	20	7	8	8	5	6	10	16	20	7	8	8	5	-77.835	-75.765
129	117	-76.8	224.567	665.5	6	10	17	20	7	6	8	6	6	10	17	20	7	6	8	6	-77.835	-75.765
130	84	-76.8	224.567	665.5	6	10	16	20	7	7	9	5	6	10	16	20	7	7	9	5	-77.835	-75.765
131	58	-76.933	223.5	665.367	6	11	15	19	8	7	9	5	6	11	15	19	8	7	9	5	-78.06	-75.807
132	109	-76.933	223.5	665.367	6	10	17	19	8	7	7	6	6	10	17	19	8	7	7	6	-78.06	-75.807
133	42	-76.933	223.5	665.367	6	11	18	17	8	6	8	6	6	11	18	17	8	6	8	6	-78.06	-75.807
134	19	-76.933	223.5	665.367	6	11	17	17	8	8	7	6	6	11	17	17	8	8	7	6	-78.06	-75.807
135	105	-76.967	223.567	665.367	6	10	15	19	9	8	8	5	6	10	15	19	9	8	8	5	-78.095	-75.838
136	113	-76.967	223.6	665.367	6	10	18	17	9	6	8	6	6	10	18	17	9	6	8	6	-78.095	-75.838
137	198	-76.967	223.567	665.367	6	10	16	18	9	7	8	6	6	10	16	18	9	7	8	6	-78.095	-75.838
138	163	-76.967	223.567	665.367	6	10	15	18	9	8	8	6	6	10	15	18	9	8	8	6	-78.095	-75.838
139	171	-76.967	223.6	665.367	6	10	17	19	9	6	8	5	6	10	17	19	9	6	8	5	-78.095	-75.838
140	213	-76.967	223.567	665.367	6	10	15	19	9	7	8	6	6	10	15	19	9	7	8	6	-78.095	-75.838
141	155	-77.3	214.667	665.5	8	10	18	17	7	6	7	5	8	10	18	17	7	6	7	5	-77.959	-76.641
142	118	-77.333	216.433	665.367	7	10	18	17	8	6	7	5	7	10	18	17	8	6	7	5	-78.001	-76.666
143	146	-77.333	216.433	665.367	7	10	15	18	8	8	7	5	7	10	15	18	8	8	7	5	-78.001	-76.666
144	101	-77.333	216.2	665.367	7	10	15	17	9	7	8	5	7	10	15	17	9	7	8	5	-78.001	-76.666
145	16	-77.8	224.567	665.5	6	11	17	20	7	7	7	6	6	11	17	20	7	7	7	6	-78.835	-76.765
146	74	-77.8	224.567	665.5	6	11	15	20	7	8	8	6	6	11	15	20	7	8	8	6	-78.835	-76.765
147	99	-77.8	224.567	665.5	6	10	18	20	7	8	7	5	6	10	18	20	7	8	7	5	-78.835	-76.765
148	231	-77.8	224.567	665.5	6	11	17	18	7	8	8	6	6	11	17	18	7	8	8	6	-78.835	-76.765
149	54	-77.933	223.5	665.367	6	10	17	20	8	7	7	6	6	10	17	20	8	7	7	6	-79.06	-76.807
150	57	-77.933	223.5	665.367	6	10	18	19	8	6	9	5	6	10	18	19	8	6	9	5	-79.06	-76.807
151	214	-77.967	223.567	665.367	6	10	16	19	9	7	8	6	6	10	16	19	9	7	8	6	-79.095	-76.838
152	125	-77.967	223.567	665.367	6	10	15	19	9	7	9	6	6	10	15	19	9	7	9	6	-79.095	-76.838
153	104	-77.967	223.6	665.367	6	11	17	19	9	6	8	5	6	11	17	19	9	6	8	5	-79.095	-76.838
154	9	-77.967	223.567	665.367	6	11	15	19	9	8	7	6	6	11	15	19	9	8	7	6	-79.095	-76.838
155	77	-78.3	215.2	665.5	7	11	15	19	7	6	8	6	7	11	15	19	7	6	8	6	-78.959	-77.641
156	71	-78.3	215.2	665.5	7	11	16	17	7	6	9	6	7	11	16	17	7	6	9	6	-78.959	-77.641
157	6	-78.3	215.2	665.5	7	10	18	17	7	7	7	6	7	10	18	17	7	7	7	6	-78.959	-77.641
158	114	-78.333	216.2	665.367	7	10	18	17	9	6	7	5	7	10	18	17	9	6	7	5	-79.001	-77.666
159	95	-78.333	216.2	665.367	7	11	16	17	9	6	8	5	7	11	16	17	9	6	8	5	-79.001	-77.666
160	97	-78.333	215.933	665.367	8	10	17	17	9	6	7	5	8	10	17	17	9	6	7	5	-79.001	-77.666
161	3	-78.333	216.433	665.367	7	10	17	17	8	6	8	6	7	10	17	17	8	6	8	6	-79.001	-77.666
162	159	-78.333	216.2	665.367	7	10	15	17	9	6	9	6	7	10	15	17	9	6	9	6	-79.001	-77.666
163	32	-78.333	216.433	665.367	7	10	15	17	8	8	9	5	7	10	15	17	8	8	9	5	-79.001	-77.666

					Response Statistics (variables)								Input Factors (Macros)								Confidence Intervals	
	Experiment	Obj Fcn	# days	# enitites	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	LOW	HIGH
164	1	-78.333	216.2	665.367	7	11	15	17	9	7	7	6	7	11	15	17	9	7	7	6	-79.001	-77.666
165	169	-78.333	216.2	665.367	7	10	15	19	9	6	7	6	7	10	15	19	9	6	7	6	-79.001	-77.666
166	202	-78.333	216.2	665.367	7	10	15	20	9	6	7	5	7	10	15	20	9	6	7	5	-79.001	-77.666
167	121	-78.933	223.5	665.367	6	11	15	20	8	8	9	5	6	11	15	20	8	8	9	5	-80.06	-77.807
168	127	-78.933	223.5	665.367	6	11	17	17	8	8	9	6	6	11	17	17	8	8	9	6	-80.06	-77.807
169	148	-78.933	223.5	665.367	6	11	18	19	8	6	8	6	6	11	18	19	8	6	8	6	-80.06	-77.807
170	224	-78.967	223.567	665.367	6	10	17	18	9	8	8	6	6	10	17	18	9	8	8	6	-80.095	-77.838
171	87	-78.967	223.567	665.367	6	11	17	19	9	8	7	5	6	11	17	19	9	8	7	5	-80.095	-77.838
172	153	-78.967	223.6	665.367	6	11	18	19	9	6	8	5	6	11	18	19	9	6	8	5	-80.095	-77.838
173	86	-78.967	223.6	665.367	6	11	17	20	9	6	8	5	6	11	17	20	9	6	8	5	-80.095	-77.838
174	63	-79.3	214.667	665.5	8	10	16	19	7	8	7	5	8	10	16	19	7	8	7	5	-79.959	-78.641
175	89	-79.3	214.667	665.5	8	11	17	17	7	8	7	5	8	11	17	17	7	8	7	5	-79.959	-78.641
176	70	-79.3	215.2	665.5	7	10	18	17	7	8	8	5	7	10	18	17	7	8	8	5	-79.959	-78.641
177	138	-79.3	215.2	665.5	7	11	16	20	7	6	7	6	7	11	16	20	7	6	7	6	-79.959	-78.641
178	222	-79.333	216.433	665.367	7	10	15	19	8	6	9	6	7	10	15	19	8	6	9	6	-80.001	-78.666
179	82	-79.333	216.433	665.367	7	10	17	18	8	6	9	5	7	10	17	18	8	6	9	5	-80.001	-78.666
180	128	-79.333	216.433	665.367	7	10	18	17	8	8	7	5	7	10	18	17	8	8	7	5	-80.001	-78.666
181	94	-79.333	216.2	665.367	8	11	15	17	9	6	8	6	8	11	15	17	9	6	8	6	-80.001	-78.666
182	158	-79.333	216.4	665.367	8	10	15	17	8	8	8	6	8	10	15	17	8	8	8	6	-80.001	-78.666
183	135	-79.333	216.2	665.367	7	10	16	18	9	7	7	6	7	10	16	18	9	7	7	6	-80.001	-78.666
184	80	-79.333	216.433	665.367	7	10	18	18	8	6	7	6	7	10	18	18	8	6	7	6	-80.001	-78.666
185	96	-79.333	216.433	665.367	7	10	15	20	8	8	7	5	7	10	15	20	8	8	7	5	-80.001	-78.666
186	141	-79.333	216.2	665.367	7	11	17	17	9	6	7	6	7	11	17	17	9	6	7	6	-80.001	-78.666
187	110	-79.333	215.933	665.367	8	11	16	18	9	6	7	5	8	11	16	18	9	6	7	5	-80.001	-78.666
188	232	-79.333	216.433	665.367	7	10	17	18	8	7	8	5	7	10	17	18	8	7	8	5	-80.001	-78.666
189	103	-79.333	216.433	665.367	7	11	16	19	8	6	8	5	7	11	16	19	8	6	8	5	-80.001	-78.666
190	147	-79.333	216.433	665.367	7	10	17	18	8	7	7	6	7	10	17	18	8	7	7	6	-80.001	-78.666
191	144	-79.967	223.567	665.367	6	11	17	20	9	8	7	5	6	11	17	20	9	8	7	5	-81.095	-78.838
192	156	-79.967	223.567	665.367	6	11	17	18	9	8	9	5	6	11	17	18	9	8	9	5	-81.095	-78.838
193	53	-80.3	215.167	665.5	8	10	15	20	7	6	9	6	8	10	15	20	7	6	9	6	-80.959	-79.641
194	129	-80.3	214.667	665.5	8	11	16	17	7	8	8	6	8	11	16	17	7	8	8	6	-80.959	-79.641
195	139	-80.3	215.2	665.5	7	10	18	19	7	7	7	6	7	10	18	19	7	7	7	6	-80.959	-79.641
196	204	-80.3	215.2	665.5	7	10	15	19	7	8	9	6	7	10	15	19	7	8	9	6	-80.959	-79.641
197	59	-80.3	215.167	665.5	8	11	15	20	7	7	8	5	8	11	15	20	7	7	8	5	-80.959	-79.641
198	79	-80.3	215.2	665.5	7	11	15	19	7	7	9	6	7	11	15	19	7	7	9	6	-80.959	-79.641
199	119	-80.333	216.433	665.367	7	11	18	18	8	6	7	6	7	11	18	18	8	6	7	6	-81.001	-79.666
200	149	-80.333	216.4	665.367	8	10	15	18	8	8	8	6	8	10	15	18	8	8	8	6	-81.001	-79.666
201	25	-80.333	216.4	665.367	8	11	15	17	8	7	9	6	8	11	15	17	8	7	9	6	-81.001	-79.666
202	137	-80.333	216.4	665.367	8	10	15	18	8	7	9	6	8	10	15	18	8	7	9	6	-81.001	-79.666
203	7	-80.333	216.433	665.367	7	10	15	19	8	8	8	6	7	10	15	19	8	8	8	6	-81.001	-79.666
204	24	-80.333	216.2	665.367	7	10	17	17	9	6	9	6	7	10	17	17	9	6	9	6	-81.001	-79.666
205	126	-80.967	223.567	665.367	6	11	18	20	9	7	8	5	6	11	18	20	9	7	8	5	-82.095	-79.838
206	60	-80.967	223.567	665.367	6	11	17	20	9	7	8	6	6	11	17	20	9	7	8	6	-82.095	-79.838
207	51	-80.967	223.567	665.367	6	11	18	18	9	8	8	6	6	11	18	18	9	8	8	6	-82.095	-79.838
208	133	-81.3	214.667	665.5	8	10	18	19	7	6	9	5	8	10	18	19	7	6	9	5	-81.959	-80.641
209	134	-81.3	215.2	665.5	7	10	16	19	7	8	9	6	7	10	16	19	7	8	9	6	-81.959	-80.641
210	122	-81.3	214.667	665.5	8	10	17	18	7	7	9	6	8	10	17	18	7	7	9	6	-81.959	-80.641
211	10	-81.333	216.2	665.367	7	11	15	17	9	8	9	6	7	11	15	17	9	8	9	6	-82.001	-80.666
212	106	-81.333	216.2	665.367	7	10	17	19	9	8	7	5	7	10	17	19	9	8	7	5	-82.001	-80.666
213	68	-81.333	215.933	665.367	8	10	16	20	9	6	8	5	8	10	16	20	9	6	8	5	-82.001	-80.666
214	150	-81.333	215.933	665.367	8	10	17	17	9	8	7	6	8	10	17	17	9	8	7	6	-82.001	-80.666
215	151	-81.333	216.1	665.367	8	10	18	19	8	7	7	5	8	10	18	19	8	7	7	5	-82.001	-80.666
216	152	-81.333	216.1	665.367	8	10	18	17	8	7	9	5	8	10	18	17	8	7	9	5	-82.001	-80.666
217	23	-81.333	216.2	665.367	7	10	17	19	9	6	9	5	7	10	17	19	9	6	9	5	-82.001	-80.666
218	85	-81.333	216.2	665.367	7	10	17	20	9	6	7	6	7	10	17	20	9	6	7	6	-82.001	-80.666
219	157	-81.967	223.567	665.367	6	11	18	20	9	7	8	6	6	11	18	20	9	7	8	6	-83.095	-80.838
220	140	-82.3	215.2	665.5	7	10	18	19	7	8	9	5	7	10	18	19	7	8	9	5	-82.959	-81.641

	Experiment	Obj Fcn	# days	# enitites	Response Statistics (variables) # MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	Input Factors (Macros) # MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	Confidence Intervals LOW	HIGH
221	78	-82.3	215.2	665.5	7	11	17	20	7	7	9	5	7	11	17	20	7	7	9	5	-82.959	-81.641
222	22	-82.333	215.933	665.367	8	11	18	17	9	6	8	6	8	11	18	17	9	6	8	6	-83.001	-81.666
223	11	-82.333	216.2	665.367	7	11	18	17	9	6	9	6	7	11	18	17	9	6	9	6	-83.001	-81.666
224	91	-82.333	215.933	665.367	8	11	18	18	9	6	7	6	8	11	18	18	9	6	7	6	-83.001	-81.666
225	116	-82.333	216.1	665.367	8	10	17	18	8	8	8	6	8	10	17	18	8	8	8	6	-83.001	-81.666
226	131	-82.333	216.1	665.367	8	11	16	20	8	7	7	6	8	11	16	20	8	7	7	6	-83.001	-81.666
227	102	-82.333	216.1	665.367	8	11	18	17	8	7	9	5	8	11	18	17	8	7	9	5	-83.001	-81.666
228	92	-82.333	216.2	665.367	7	11	18	18	9	6	9	5	7	11	18	18	9	6	9	5	-83.001	-81.666
229	93	-82.333	216.1	665.367	8	10	17	18	8	8	9	5	8	10	17	18	8	8	9	5	-83.001	-81.666
230	8	-82.333	216.433	665.367	7	10	18	19	8	7	8	6	7	10	18	19	8	7	8	6	-83.001	-81.666
231	21	-82.333	216.1	665.367	8	11	17	17	8	7	9	6	8	11	17	17	8	7	9	6	-83.001	-81.666
232	107	-82.333	216.1	665.367	8	11	18	18	8	7	8	5	8	11	18	18	8	7	8	5	-83.001	-81.666
233	61	-82.333	216.433	665.367	7	11	17	19	8	6	9	6	7	11	17	19	8	6	9	6	-83.001	-81.666
234	56	-82.333	215.933	665.367	8	11	16	20	9	7	7	5	8	11	16	20	9	7	7	5	-83.001	-81.666
235	115	-83.3	215.2	665.5	7	10	18	19	7	8	9	6	7	10	18	19	7	8	9	6	-83.959	-82.641
236	4	-83.3	214.667	665.5	8	11	17	19	7	7	9	6	8	11	17	19	7	7	9	6	-83.959	-82.641
237	52	-83.333	216.1	665.367	8	10	16	20	8	8	8	6	8	10	16	20	8	8	8	6	-84.001	-82.666
238	14	-83.333	215.933	665.367	8	11	17	19	9	7	7	6	8	11	17	19	9	7	7	6	-84.001	-82.666
239	20	-83.333	215.933	665.367	8	11	18	20	9	6	7	5	8	11	18	20	9	6	7	5	-84.001	-82.666
240	88	-83.333	216.2	665.367	8	11	15	20	9	8	7	6	8	11	15	20	9	8	7	6	-84.001	-82.666
241	67	-83.333	216.1	665.367	8	10	18	20	8	7	7	6	8	10	18	20	8	7	7	6	-84.001	-82.666
242	75	-83.333	216.1	665.367	8	11	17	19	8	8	8	5	8	11	17	19	8	8	8	5	-84.001	-82.666
243	83	-83.333	216.433	665.367	7	10	18	20	8	7	8	6	7	10	18	20	8	7	8	6	-84.001	-82.666
244	27	-83.333	216.2	665.367	8	10	15	20	9	8	8	6	8	10	15	20	9	8	8	6	-84.001	-82.666
245	111	-83.333	215.933	665.367	8	10	18	20	9	6	7	6	8	10	18	20	9	6	7	6	-84.001	-82.666
246	123	-83.333	216.433	665.367	7	11	16	20	8	8	8	6	7	11	16	20	8	8	8	6	-84.001	-82.666
247	112	-83.333	216.1	665.367	8	10	18	19	8	7	9	5	8	10	18	19	8	7	9	5	-84.001	-82.666
248	120	-84.333	216.433	665.367	7	11	17	20	8	7	9	6	7	11	17	20	8	7	9	6	-85.001	-83.666
249	154	-84.333	216.2	665.367	7	11	17	20	9	6	9	6	7	11	17	20	9	6	9	6	-85.001	-83.666
250	5	-84.333	216.2	665.367	8	11	15	19	9	8	9	6	8	11	15	19	9	8	9	6	-85.001	-83.666
251	73	-84.333	216.2	665.367	7	11	18	19	9	7	9	5	7	11	18	19	9	7	9	5	-85.001	-83.666
252	69	-84.333	216.2	665.367	7	10	17	20	9	8	9	5	7	10	17	20	9	8	9	5	-85.001	-83.666
253	81	-84.333	216.1	665.367	8	11	17	18	8	8	9	6	8	11	17	18	8	8	9	6	-85.001	-83.666
254	132	-85.333	215.933	665.367	8	11	17	20	9	7	8	6	8	11	17	20	9	7	8	6	-86.001	-84.666
255	17	-85.333	216.433	665.367	7	11	18	20	8	8	8	6	7	11	18	20	8	8	8	6	-86.001	-84.666
256	143	-85.333	215.933	665.367	8	10	18	18	9	8	9	6	8	10	18	18	9	8	9	6	-86.001	-84.666
257	90	-86.333	215.933	665.367	8	10	17	20	9	8	9	6	8	10	17	20	9	8	9	6	-87.001	-85.666
258	18	-86.333	216.1	665.367	8	11	17	20	8	8	9	6	8	11	17	20	8	8	9	6	-87.001	-85.666
259	100	-86.333	215.933	665.367	8	11	18	20	9	7	8	6	8	11	18	20	9	7	8	6	-87.001	-85.666
260	142	-87.333	216.2	665.367	7	11	18	20	9	8	9	6	7	11	18	20	9	8	9	6	-88.001	-86.666

Appendix M: Optimization Output – Medium BCTC

Medium BCTC Optimization Results (from CAUTIOUS Profile Experiment)

					Response Statistics (variables)								Input Factors (Macros)								Confidence Intervals	
	Experiment	Obj Fcn	# days	# enitites	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	LOW	HIGH
1	90	-59.27	222.4	603.8	6	8	12	15	6	5	7	4	6	8	12	12	6	5	7	4	-59.875	-58.665
2	47	-60.27	222.333	603.8	6	8	12	15	7	5	7	4	6	8	12	12	7	5	7	4	-60.875	-59.665
3	73	-60.27	222.4	603.8	6	8	13	16	7	5	7	4	6	8	13	12	6	5	7	4	-60.875	-59.665
4	82	-60.27	222.4	603.8	6	8	12	14	6	6	7	4	6	8	12	12	6	6	7	4	-60.875	-59.665
5	87	-60.27	222.4	603.8	6	8	12	15	8	5	7	5	6	8	12	12	6	5	7	5	-60.875	-59.665
6	88	-60.27	222.4	603.8	6	8	12	15	6	5	8	4	6	8	12	12	6	5	8	4	-60.875	-59.665
7	45	-60.27	222.4	603.8	6	8	12	15	8	5	7	4	6	8	12	13	6	5	7	4	-60.875	-59.665
8	49	-61.27	222.333	603.8	6	8	12	16	7	5	7	4	6	8	12	13	7	5	7	4	-61.875	-60.665
9	52	-61.27	222.4	603.8	6	8	12	16	8	5	7	4	6	9	12	13	6	5	7	4	-61.875	-60.665
10	56	-61.27	222.4	603.8	6	8	13	16	8	5	8	4	6	8	13	12	6	5	8	4	-61.875	-60.665
	Average Values:		222.39	603.80	6.00	8.00	12.20	15.30	7.10	5.10	7.20	4.10										
			223	604	6	8	13	16	8	6	8	5										

Training Staff	LWN Cisco Optr	Mgmt Staff	Turbulence	TOTAL
51	2	13	10%	72.6

11	62	-61.27	222.333	603.8	6	8	13	12	7	5	7	4	6	8	13	12	7	5	7	4	-61.875	-60.665
12	63	-61.27	222.4	603.8	6	8	12	12	6	6	8	4	6	8	12	12	6	6	8	4	-61.875	-60.665
13	69	-61.27	222.4	603.8	6	8	12	12	6	6	7	5	6	8	12	12	6	6	7	5	-61.875	-60.665
14	70	-61.27	222.333	603.8	6	9	12	12	7	5	7	4	6	9	12	12	7	5	7	4	-61.875	-60.665
15	35	-61.27	222.4	603.8	6	8	12	12	6	5	8	5	6	8	12	12	6	5	8	5	-61.875	-60.665
16	43	-61.27	222.4	603.8	6	8	12	13	6	5	8	4	6	8	12	13	6	5	8	4	-61.875	-60.665
17	86	-61.27	222.4	603.8	6	8	13	13	6	5	7	4	6	8	13	13	6	5	7	4	-61.875	-60.665
18	44	-61.27	222.4	603.8	6	8	12	13	6	6	7	4	6	8	12	13	6	6	7	4	-61.875	-60.665
19	24	-61.27	222.4	603.8	6	8	13	12	6	5	7	5	6	8	13	12	6	5	7	5	-61.875	-60.665
20	34	-61.27	222.4	603.8	6	8	13	12	6	6	7	4	6	8	13	12	6	6	7	4	-61.875	-60.665
21	91	-61.27	222.4	603.8	6	9	12	12	6	6	7	4	6	9	12	12	6	6	7	4	-61.875	-60.665
22	92	-61.27	222.4	603.8	6	8	12	13	6	5	7	5	6	8	12	13	6	5	7	5	-61.875	-60.665
23	93	-61.27	222.333	603.8	6	8	12	12	7	6	7	4	6	8	12	12	7	6	7	4	-61.875	-60.665
24	61	-62.27	222.333	603.8	6	9	12	12	7	5	8	4	6	9	12	12	7	5	8	4	-62.875	-61.665
25	39	-62.27	222.333	603.8	6	9	12	13	7	5	7	4	6	9	12	13	7	5	7	4	-62.875	-61.665
26	40	-62.27	222.4	603.8	6	9	12	13	6	5	8	4	6	9	12	13	6	5	8	4	-62.875	-61.665
27	64	-62.27	222.4	603.8	6	8	13	13	6	6	7	4	6	8	13	13	6	6	7	4	-62.875	-61.665
28	65	-62.27	222.333	603.8	6	8	12	12	7	6	8	4	6	8	12	12	7	6	8	4	-62.875	-61.665
29	67	-62.27	222.333	603.8	6	8	12	13	7	6	7	4	6	8	12	13	7	6	7	4	-62.875	-61.665
30	25	-62.27	222.333	603.8	6	8	13	12	7	5	7	5	6	8	13	12	7	5	7	5	-62.875	-61.665
31	29	-62.27	222.333	603.8	6	8	12	12	7	6	7	5	6	8	12	12	7	6	7	5	-62.875	-61.665
32	30	-62.27	222.4	603.8	6	8	12	13	6	5	8	5	6	8	12	13	6	5	8	5	-62.875	-61.665
33	78	-62.27	222.4	603.8	6	9	12	13	6	5	7	5	6	9	12	13	6	5	7	5	-62.875	-61.665
34	79	-62.27	222.333	603.8	6	8	12	13	7	5	7	5	6	8	12	13	7	5	7	5	-62.875	-61.665
35	80	-62.27	222.4	603.8	6	8	12	12	6	6	8	5	6	8	12	12	6	6	8	5	-62.875	-61.665
36	46	-62.27	222.4	603.8	6	8	13	13	6	5	8	4	6	8	13	13	6	5	8	4	-62.875	-61.665
37	85	-62.27	222.4	603.8	6	9	12	13	6	6	7	4	6	9	12	13	6	6	7	4	-62.875	-61.665
38	32	-62.27	222.4	603.8	6	9	12	12	6	6	7	5	6	9	12	12	6	6	7	5	-62.875	-61.665
39	23	-62.27	222.4	603.8	6	8	13	12	6	5	8	5	6	8	13	12	6	5	8	5	-62.875	-61.665
40	51	-62.27	222.4	603.8	6	9	12	12	6	5	8	5	6	9	12	12	6	5	8	5	-62.875	-61.665
41	89	-62.27	222.333	603.8	6	8	13	12	7	6	7	4	6	8	13	12	7	6	7	4	-62.875	-61.665
42	6	-62.27	222.4	603.8	6	8	13	12	6	6	7	5	6	8	13	12	6	6	7	5	-62.875	-61.665
43	37	-62.27	222.4	603.8	6	8	13	13	6	5	7	5	6	8	13	13	6	5	7	5	-62.875	-61.665
44	58	-62.27	222.4	603.8	6	9	13	12	6	6	7	4	6	9	13	12	6	6	7	4	-62.875	-61.665
45	60	-62.27	222.4	603.8	6	8	13	12	6	6	8	4	6	8	13	12	6	6	8	4	-62.875	-61.665
46	94	-62.27	222.4	603.8	6	9	13	13	6	5	7	4	6	9	13	13	6	5	7	4	-62.875	-61.665
47	1	-63.27	222.333	603.8	6	9	12	12	7	6	7	5	6	9	12	12	7	6	7	5	-63.875	-62.665
48	3	-63.27	222.333	603.8	6	8	13	12	7	5	8	5	6	8	13	12	7	5	8	5	-63.875	-62.665

					Response Statistics (variables)								Input Factors (Macros)								Confidence Intervals	
	Experiment	Obj Fcn	# days	# enitites	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	LOW	HIGH
49	72	-63.27	222.4	603.8	6	8	13	13	6	5	8	5	6	8	13	13	6	5	8	5	-63.875	-62.665
50	15	-63.27	222.333	603.8	6	9	12	12	7	5	8	5	6	9	12	12	7	5	8	5	-63.875	-62.665
51	75	-63.27	222.4	603.8	6	9	12	13	6	6	7	5	6	9	12	13	6	6	7	5	-63.875	-62.665
52	76	-63.27	222.333	603.8	6	8	12	13	7	5	8	5	6	8	12	13	7	5	8	5	-63.875	-62.665
53	77	-63.27	222.4	603.8	6	9	12	12	6	6	8	5	6	9	12	12	6	6	8	5	-63.875	-62.665
54	57	-63.27	222.333	603.8	6	8	13	13	7	5	7	5	6	8	13	13	7	5	7	5	-63.875	-62.665
55	26	-63.27	222.333	603.8	6	8	13	12	7	6	7	5	6	8	13	12	7	6	7	5	-63.875	-62.665
56	59	-63.27	222.333	603.8	6	9	13	12	7	5	8	4	6	9	13	12	7	5	8	4	-63.875	-62.665
57	81	-63.27	222.4	603.8	6	8	13	13	6	6	8	4	6	8	13	13	6	6	8	4	-63.875	-62.665
58	27	-63.27	222.4	603.8	6	8	13	12	6	6	8	5	6	8	13	12	6	6	8	5	-63.875	-62.665
59	28	-63.27	222.4	603.8	6	9	13	12	6	6	7	5	6	9	13	12	6	6	7	5	-63.875	-62.665
60	19	-63.27	222.333	603.8	6	9	13	13	7	5	7	4	6	9	13	13	7	5	7	4	-63.875	-62.665
61	21	-63.27	222.333	603.8	6	8	13	13	7	5	8	4	6	8	13	13	7	5	8	4	-63.875	-62.665
62	22	-63.27	222.4	603.8	6	9	12	13	6	5	8	5	6	9	12	13	6	5	8	5	-63.875	-62.665
63	33	-63.27	222.333	603.8	6	9	13	12	7	5	7	5	6	9	13	12	7	5	7	5	-63.875	-62.665
64	66	-63.27	222.4	603.8	6	9	13	12	6	6	8	4	6	9	13	12	6	6	8	4	-63.875	-62.665
65	12	-63.27	222.333	603.8	6	8	12	12	7	6	8	5	6	8	12	12	7	6	8	5	-63.875	-62.665
66	68	-63.27	222.333	603.8	6	8	13	13	7	6	7	4	6	8	13	13	7	6	7	4	-63.875	-62.665
67	13	-63.27	222.333	603.8	6	9	12	12	7	6	8	4	6	9	12	12	7	6	8	4	-63.875	-62.665
68	36	-63.27	222.4	603.8	6	8	12	13	6	6	8	5	6	8	12	13	6	6	8	5	-63.875	-62.665
69	2	-64.27	222.333	603.8	6	9	12	13	7	5	8	5	6	9	12	13	7	5	8	5	-64.875	-63.665
70	7	-64.27	222.333	603.8	6	8	12	13	7	6	8	5	6	8	12	13	7	6	8	5	-64.875	-63.665
71	9	-64.27	222.333	603.8	6	9	12	13	7	6	7	5	6	9	12	13	7	6	7	5	-64.875	-63.665
72	10	-64.27	222.333	603.8	6	9	12	12	7	6	8	5	6	9	12	12	7	6	8	5	-64.875	-63.665
73	16	-64.27	222.4	603.8	6	9	13	13	6	6	7	5	6	9	13	13	6	6	7	5	-64.875	-63.665
74	48	-64.27	222.333	603.8	6	8	13	13	7	6	7	5	6	8	13	13	7	6	7	5	-64.875	-63.665
75	38	-64.27	222.4	603.8	6	9	12	13	6	6	8	5	6	9	12	13	6	6	8	5	-64.875	-63.665
76	50	-64.27	222.333	603.8	6	8	13	13	7	6	8	4	6	8	13	13	7	6	8	4	-64.875	-63.665
77	84	-64.27	222.333	603.8	6	9	13	12	7	6	8	4	6	9	13	12	7	6	8	4	-64.875	-63.665
78	31	-64.27	222.333	603.8	6	8	13	12	7	6	8	5	6	8	13	12	7	6	8	5	-64.875	-63.665
79	18	-64.27	222.333	603.8	6	9	13	12	7	6	7	5	6	9	13	12	7	6	7	5	-64.875	-63.665
80	53	-64.27	222.333	603.8	6	9	13	13	7	5	8	4	6	9	13	13	7	5	8	4	-64.875	-63.665
81	54	-64.27	222.333	603.8	6	9	13	13	7	6	7	4	6	9	13	13	7	6	7	4	-64.875	-63.665
82	55	-64.27	222.4	603.8	6	9	13	13	6	6	8	4	6	9	13	13	6	6	8	4	-64.875	-63.665
83	71	-64.27	222.4	603.8	6	8	13	13	6	6	8	5	6	8	13	13	6	6	8	5	-64.875	-63.665
84	41	-64.27	222.333	603.8	6	9	13	13	7	5	7	5	6	9	13	13	7	5	7	5	-64.875	-63.665
85	42	-64.27	222.4	603.8	6	9	13	13	6	5	8	5	6	9	13	13	6	5	8	5	-64.875	-63.665
86	74	-64.27	222.333	603.8	6	9	12	13	7	6	8	4	6	9	12	13	7	6	8	4	-64.875	-63.665
87	11	-64.27	222.333	603.8	6	9	13	12	7	5	8	5	6	9	13	12	7	5	8	5	-64.875	-63.665
88	4	-65.27	222.4	603.8	6	9	13	13	6	6	8	5	6	9	13	13	6	6	8	5	-65.875	-64.665
89	20	-65.27	222.333	603.8	6	9	13	12	7	6	8	5	6	9	13	12	7	6	8	5	-65.875	-64.665
90	5	-65.27	222.333	603.8	6	9	12	13	7	6	8	5	6	9	12	13	7	6	8	5	-65.875	-64.665
91	14	-65.27	222.333	603.8	6	9	13	13	7	6	7	5	6	9	13	13	7	6	7	5	-65.875	-64.665
92	83	-65.27	222.333	603.8	6	9	13	13	7	5	8	5	6	9	13	13	7	5	8	5	-65.875	-64.665
93	8	-65.27	222.333	603.8	6	8	13	13	7	6	8	5	6	8	13	13	7	6	8	5	-65.875	-64.665
94	17	-66.27	222.333	603.8	6	9	13	13	7	6	8	5	6	9	13	13	7	6	8	5	-66.875	-65.665

Appendix N: Optimization Output - Small BCTC

Small BCTC Optimization Results (from CAUTIOUS Profile Experiment)

					Response Statistics (variables)								Input Factors (Macros)								Confidence Intervals	
	Experiment	Obj Fcn	# days	# enitites	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	LOW	HIGH
1	42	-30.633	215.2	191.867	3	4	6	7	3	2	3	3	3	4	6	7	3	2	3	3	-31.006	-30.26
2	41	-31.6	215.167	191.9	3	4	6	7	4	2	3	3	3	4	6	7	4	2	3	3	-31.975	-31.225
3	37	-31.633	215.2	191.867	3	4	6	7	3	2	4	3	3	4	6	7	3	2	4	3	-32.006	-31.26
4	43	-31.633	215.2	191.867	3	5	6	7	3	2	3	3	3	5	6	7	3	2	3	3	-32.006	-31.26
5	46	-31.633	215.2	191.867	3	4	6	7	3	2	3	3	4	4	6	7	3	2	3	3	-32.006	-31.26
6	47	-31.633	215.2	191.867	3	4	6	7	3	3	3	3	3	4	6	7	3	3	3	3	-32.006	-31.26
7	136	-31.633	215.2	191.867	3	4	7	7	3	2	3	3	3	4	7	7	3	2	3	3	-32.006	-31.26
8	147	-31.633	215.2	191.867	3	4	6	8	3	2	3	3	3	4	6	8	3	2	3	3	-32.006	-31.26
9	34	-32.6	215.167	191.9	3	4	6	7	4	2	4	3	3	4	6	7	4	2	4	3	-32.975	-32.225
10	48	-32.6	215.167	191.9	3	5	6	7	4	2	3	3	3	5	6	7	4	2	3	3	-32.975	-32.225
	Average Values:		215.19	191.88	3.00	4.20	6.10	7.10	3.30	2.10	3.20	3.00										
			216	192	3	5	7	8	4	3	4	3										

Training Staff	LWN Cisco Optr	Mgmt Staff	Turbulence	TOTAL
26	2	2	10%	33

	Experiment	Obj Fcn	# days	# enitites	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	LOW	HIGH
11	63	-32.6	215.167	191.9	4	4	6	7	4	2	3	3	4	4	6	7	4	2	3	3	-32.975	-32.225
12	45	-32.6	215.167	191.9	3	4	6	7	4	2	3	4	3	4	6	7	4	2	3	4	-32.975	-32.225
13	137	-32.6	215.167	191.9	3	4	6	8	4	2	3	3	3	4	6	8	4	2	3	3	-32.975	-32.225
14	38	-32.6	215.167	191.9	3	4	6	7	4	3	3	3	3	4	6	7	4	3	3	3	-32.975	-32.225
15	149	-32.6	215.167	191.9	3	4	7	7	4	2	3	3	3	4	7	7	4	2	3	3	-32.975	-32.225
16	69	-32.633	215.2	191.867	3	5	6	8	3	2	3	3	3	5	6	8	3	2	3	3	-33.006	-32.26
17	96	-32.633	215.2	191.867	3	4	6	7	3	3	3	4	3	4	6	7	3	3	3	4	-33.006	-32.26
18	105	-32.633	215.2	191.867	3	4	8	7	3	2	3	3	3	4	8	7	3	2	3	3	-33.006	-32.26
19	127	-32.633	215.2	191.867	4	4	6	7	3	3	3	3	4	4	6	7	3	3	3	3	-33.006	-32.26
20	40	-32.633	215.2	191.867	3	4	6	8	3	2	4	3	3	4	6	8	3	2	4	3	-33.006	-32.26
21	33	-32.633	215.2	191.867	3	4	6	7	3	3	4	3	3	4	6	7	3	3	4	3	-33.006	-32.26
22	140	-32.633	215.2	191.867	3	4	7	7	3	2	4	3	3	4	7	7	3	2	4	3	-33.006	-32.26
23	145	-32.633	215.2	191.867	3	4	7	7	3	2	3	4	3	4	7	7	3	2	3	4	-33.006	-32.26
24	62	-32.633	215.2	191.867	4	4	6	8	3	2	3	3	4	4	6	8	3	2	3	3	-33.006	-32.26
25	148	-32.633	215.2	191.867	3	4	6	8	3	3	3	3	3	4	6	8	3	3	3	3	-33.006	-32.26
26	28	-32.633	215.2	191.867	3	4	6	7	3	2	4	4	3	4	6	7	3	2	4	4	-33.006	-32.26
27	150	-32.633	215.2	191.867	3	4	6	8	3	2	3	4	3	4	6	8	3	2	3	4	-33.006	-32.26
28	155	-32.633	215.2	191.867	4	4	7	7	3	2	3	3	4	4	7	7	3	2	3	3	-33.006	-32.26
29	161	-32.633	215.2	191.867	4	4	6	7	3	2	3	4	4	4	6	7	3	2	3	4	-33.006	-32.26
30	30	-33.6	215.167	191.9	3	4	6	7	4	3	4	3	3	4	6	7	4	3	4	3	-33.975	-33.225
31	138	-33.6	215.167	191.9	3	5	6	8	4	2	3	3	3	5	6	8	4	2	3	3	-33.975	-33.225
32	88	-33.6	215.167	191.9	4	4	7	7	4	2	3	3	4	4	7	7	4	2	3	3	-33.975	-33.225
33	141	-33.6	215.167	191.9	3	4	6	7	4	3	3	4	3	4	6	7	4	3	3	4	-33.975	-33.225
34	142	-33.6	215.167	191.9	4	4	6	7	4	2	3	4	4	4	6	7	4	2	3	4	-33.975	-33.225
35	143	-33.6	215.167	191.9	4	4	6	7	4	3	3	3	4	4	6	7	4	3	3	3	-33.975	-33.225
36	144	-33.6	215.167	191.9	3	5	7	7	4	2	3	3	3	5	7	7	4	2	3	3	-33.975	-33.225
37	94	-33.6	215.167	191.9	3	4	6	8	4	3	3	3	3	4	6	8	4	3	3	3	-33.975	-33.225
38	44	-33.6	215.167	191.9	3	5	6	7	4	3	3	3	3	5	6	7	4	3	3	3	-33.975	-33.225
39	32	-33.6	215.167	191.9	3	4	6	7	4	2	4	4	3	4	6	7	4	2	4	4	-33.975	-33.225
40	120	-33.6	215.167	191.9	3	4	6	8	4	2	3	4	3	4	6	8	4	2	3	4	-33.975	-33.225
41	126	-33.6	215.167	191.9	3	4	8	7	4	2	3	3	3	4	8	7	4	2	3	3	-33.975	-33.225
42	29	-33.6	215.167	191.9	3	5	6	7	4	2	4	3	3	5	6	7	4	2	4	3	-33.975	-33.225
43	65	-33.6	215.167	191.9	4	4	6	8	4	2	3	3	4	4	6	8	4	2	3	3	-33.975	-33.225
44	27	-33.633	215.2	191.867	3	5	6	8	3	2	4	3	3	5	6	8	3	2	4	3	-34.006	-33.26
45	39	-33.633	215.2	191.867	3	5	6	7	3	3	4	3	3	5	6	7	3	3	4	3	-34.006	-33.26
46	110	-33.633	215.2	191.867	4	4	6	7	3	2	4	4	4	4	6	7	3	2	4	4	-34.006	-33.26
47	113	-33.633	215.2	191.867	3	4	8	7	3	3	3	3	3	4	8	7	3	3	3	3	-34.006	-33.26
48	115	-33.633	215.2	191.867	3	5	6	7	3	3	3	4	3	5	6	7	3	3	3	4	-34.006	-33.26

					Response Statistics (variables)								Input Factors (Macros)								Confidence Intervals	
	Experiment	Obj Fcn	# days	# enitites	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	LOW	HIGH
49	49	-33.633	215.2	191.867	3	4	7	7	3	2	4	4	3	4	7	7	3	2	4	4	-34.006	-33.26
50	122	-33.633	215.2	191.867	3	5	6	8	3	2	3	4	3	5	6	8	3	2	3	4	-34.006	-33.26
51	146	-33.633	215.2	191.867	3	4	6	7	3	3	4	4	3	4	6	7	3	3	4	4	-34.006	-33.26
52	87	-33.633	215.2	191.867	4	4	6	8	3	3	3	3	4	4	6	8	3	3	3	3	-34.006	-33.26
53	60	-33.633	215.2	191.867	3	4	7	8	3	2	4	3	3	4	7	8	3	2	4	3	-34.006	-33.26
54	132	-33.633	215.167	191.867	4	4	8	7	3	2	3	3	4	4	8	7	3	2	3	3	-34.006	-33.26
55	135	-33.633	215.2	191.867	4	4	6	7	3	3	3	4	4	4	6	7	3	3	3	4	-34.006	-33.26
56	152	-33.633	215.2	191.867	3	4	7	7	3	3	3	4	3	4	7	7	3	3	3	4	-34.006	-33.26
57	92	-33.633	215.2	191.867	3	5	7	8	3	2	3	3	3	5	7	8	3	2	3	3	-34.006	-33.26
58	156	-33.633	215.2	191.867	3	4	8	7	3	2	4	3	3	4	8	7	3	2	4	3	-34.006	-33.26
59	159	-33.633	215.2	191.867	3	4	7	7	3	3	4	3	3	4	7	7	3	3	4	3	-34.006	-33.26
60	24	-33.633	215.2	191.867	3	5	6	7	3	2	4	4	3	5	6	7	3	2	4	4	-34.006	-33.26
61	15	-34.6	215.167	191.9	3	5	6	7	4	2	4	4	3	5	6	7	4	2	4	4	-34.975	-34.225
62	12	-34.6	215.167	191.9	3	4	6	7	4	3	4	4	3	4	6	7	4	3	4	4	-34.975	-34.225
63	13	-34.6	215.167	191.9	3	5	6	7	4	3	4	3	3	5	6	7	4	3	4	3	-34.975	-34.225
64	93	-34.6	215.167	191.9	3	5	7	8	4	2	3	3	3	5	7	8	4	2	3	3	-34.975	-34.225
65	31	-34.6	215.167	191.9	3	5	6	7	4	3	3	4	3	5	6	7	4	3	3	4	-34.975	-34.225
66	128	-34.6	215.167	191.9	4	4	6	7	4	3	3	4	4	4	6	7	4	3	3	4	-34.975	-34.225
67	55	-34.6	215.167	191.9	4	5	6	8	4	2	3	3	4	5	6	8	4	2	3	3	-34.975	-34.225
68	98	-34.6	215.167	191.9	4	5	7	7	4	2	3	3	4	5	7	7	4	2	3	3	-34.975	-34.225
69	101	-34.6	215.133	191.9	4	4	8	7	4	2	3	3	4	4	8	7	4	2	3	3	-34.975	-34.225
70	151	-34.6	215.167	191.9	3	4	6	8	4	3	3	4	3	4	6	8	4	3	3	4	-34.975	-34.225
71	73	-34.6	215.167	191.9	3	4	8	7	4	2	3	4	3	4	8	7	4	2	3	4	-34.975	-34.225
72	153	-34.6	215.167	191.9	3	4	8	7	4	2	4	3	3	4	8	7	4	2	4	3	-34.975	-34.225
73	77	-34.6	215.167	191.9	3	4	7	8	4	2	3	4	3	4	7	8	4	2	3	4	-34.975	-34.225
74	139	-34.6	215.167	191.9	4	4	6	8	4	3	3	3	4	4	6	8	4	3	3	3	-34.975	-34.225
75	157	-34.6	215.167	191.9	3	4	6	8	4	3	4	3	3	4	6	8	4	3	4	3	-34.975	-34.225
76	111	-34.6	215.167	191.9	3	4	6	8	4	2	4	4	3	4	6	8	4	2	4	4	-34.975	-34.225
77	160	-34.6	215.167	191.9	3	4	8	7	4	3	3	3	3	4	8	7	4	3	3	3	-34.975	-34.225
78	86	-34.6	215.167	191.9	4	5	6	7	4	2	4	3	4	5	6	7	4	2	4	3	-34.975	-34.225
79	81	-34.633	215.2	191.867	4	5	7	7	3	3	3	3	4	5	7	7	3	3	3	3	-35.006	-34.26
80	84	-34.633	215.2	191.867	4	4	7	7	3	3	4	3	4	4	7	7	3	3	4	3	-35.006	-34.26
81	23	-34.633	215.2	191.867	3	5	6	8	3	2	4	4	3	5	6	8	3	2	4	4	-35.006	-34.26
82	57	-34.633	215.2	191.867	4	5	6	8	3	2	4	3	4	5	6	8	3	2	4	3	-35.006	-34.26
83	67	-34.633	215.167	191.867	4	4	8	7	3	3	3	3	4	4	8	7	3	3	3	3	-35.006	-34.26
84	89	-34.633	215.2	191.867	3	4	8	8	3	3	3	3	3	4	8	8	3	3	3	3	-35.006	-34.26
85	116	-34.633	215.2	191.867	4	5	6	8	3	2	3	4	4	5	6	8	3	2	3	4	-35.006	-34.26
86	154	-34.633	215.167	191.867	4	4	8	8	3	2	3	3	4	4	8	8	3	2	3	3	-35.006	-34.26
87	68	-34.633	215.2	191.867	4	5	6	7	3	2	4	4	4	5	6	7	3	2	4	4	-35.006	-34.26
88	121	-34.633	215.2	191.867	4	4	6	7	3	3	4	4	4	4	6	7	3	3	4	4	-35.006	-34.26
89	52	-34.633	215.2	191.867	4	4	6	8	3	2	4	4	4	4	6	8	3	2	4	4	-35.006	-34.26
90	158	-34.633	215.2	191.867	3	4	7	8	3	2	4	4	3	4	7	8	3	2	4	4	-35.006	-34.26
91	61	-34.633	215.2	191.867	4	4	7	8	3	3	3	3	4	4	7	8	3	3	3	3	-35.006	-34.26
92	75	-34.633	215.167	191.867	4	4	8	7	3	2	4	3	4	4	8	7	3	2	4	3	-35.006	-34.26
93	53	-34.633	215.2	191.867	3	4	8	8	3	2	3	4	3	4	8	8	3	2	3	4	-35.006	-34.26
94	26	-35.6	215.167	191.9	3	5	6	7	4	3	4	4	3	5	6	7	4	3	4	4	-35.975	-35.225
95	2	-35.6	215.167	191.9	3	5	6	8	4	2	4	4	3	5	6	8	4	2	4	4	-35.975	-35.225
96	56	-35.6	215.167	191.9	3	4	8	8	4	2	4	3	3	4	8	8	4	2	4	3	-35.975	-35.225
97	35	-35.6	215.167	191.9	3	4	8	7	4	3	4	3	3	4	8	7	4	3	4	3	-35.975	-35.225
98	95	-35.6	215.167	191.9	3	4	8	8	4	3	3	3	3	4	8	8	4	3	3	3	-35.975	-35.225
99	36	-35.6	215.167	191.9	3	5	8	7	4	2	4	3	3	5	8	7	4	2	4	3	-35.975	-35.225
100	97	-35.6	215.167	191.9	3	4	7	8	4	3	3	4	3	4	7	8	4	3	3	4	-35.975	-35.225
101	78	-35.6	215.167	191.9	3	5	8	8	4	2	3	3	3	5	8	8	4	2	3	3	-35.975	-35.225
102	79	-35.6	215.167	191.9	3	5	7	8	4	3	3	3	3	5	7	8	4	3	3	3	-35.975	-35.225
103	3	-35.6	215.167	191.9	4	4	7	7	4	2	4	4	4	4	7	7	4	2	4	4	-35.975	-35.225
104	107	-35.6	215.167	191.9	3	5	6	8	4	3	4	3	3	5	6	8	4	3	4	3	-35.975	-35.225
105	19	-35.6	215.167	191.9	3	5	7	7	4	3	3	4	3	5	7	7	4	3	3	4	-35.975	-35.225

					Response Statistics (variables)								Input Factors (Macros)								Confidence Intervals	
	Experiment	Obj Fcn	# days	# enitites	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	# MPCR	# RTOC Bays	# IT Staff	# CT Staff	# S/S Staff	# Tech Spt	# Tng Spt	# Networks	LOW	HIGH
106	85	-35.6	215.167	191.9	4	5	6	7	4	2	4	4	4	5	6	7	4	2	4	4	-35.975	-35.225
107	22	-35.6	215.167	191.9	4	4	7	8	4	2	4	3	4	4	7	8	4	2	4	3	-35.975	-35.225
108	9	-35.6	215.167	191.9	3	5	6	8	4	3	3	4	3	5	6	8	4	3	3	4	-35.975	-35.225
109	1	-35.6	215.167	191.9	4	5	6	7	4	3	3	4	4	5	6	7	4	3	3	4	-35.975	-35.225
110	119	-35.6	215.167	191.9	4	4	7	7	4	3	3	4	4	4	7	7	4	3	3	4	-35.975	-35.225
111	6	-35.633	215.167	191.867	4	4	8	7	3	3	3	4	4	4	8	7	3	3	3	4	-36.006	-35.26
112	16	-35.633	215.2	191.867	3	5	7	8	3	3	3	4	3	5	7	8	3	3	3	4	-36.006	-35.26
113	123	-35.633	215.2	191.867	3	4	8	8	3	3	4	3	3	4	8	8	3	3	4	3	-36.006	-35.26
114	54	-35.633	215.2	191.867	3	5	6	8	3	3	4	4	3	5	6	8	3	3	4	4	-36.006	-35.26
115	104	-35.633	215.2	191.867	3	4	8	8	3	2	4	4	3	4	8	8	3	2	4	4	-36.006	-35.26
116	25	-35.633	215.2	191.867	3	5	7	8	3	2	4	4	3	5	7	8	3	2	4	4	-36.006	-35.26
117	129	-35.633	215.167	191.867	4	4	8	8	3	3	3	3	4	4	8	8	3	3	3	3	-36.006	-35.26
118	130	-35.633	215.167	191.867	4	4	8	7	3	3	4	3	4	4	8	7	3	3	4	3	-36.006	-35.26
119	117	-35.633	215.167	191.867	4	4	8	8	3	2	4	3	4	4	8	8	3	2	4	3	-36.006	-35.26
120	118	-35.633	215.2	191.867	3	4	7	8	3	3	4	4	3	4	7	8	3	3	4	4	-36.006	-35.26
121	76	-35.633	215.167	191.867	4	4	8	8	3	2	3	4	4	4	8	8	3	2	3	4	-36.006	-35.26
122	109	-35.633	215.2	191.867	4	5	6	8	3	3	3	4	4	5	6	8	3	3	3	4	-36.006	-35.26
123	133	-36.6	215.167	191.9	3	5	8	7	4	3	4	3	3	5	8	7	4	3	4	3	-36.975	-36.225
124	70	-36.6	215.167	191.9	3	5	8	8	4	2	4	3	3	5	8	8	4	2	4	3	-36.975	-36.225
125	103	-36.6	215.133	191.9	4	4	8	7	4	3	3	4	4	4	8	7	4	3	3	4	-36.975	-36.225
126	80	-36.6	215.167	191.9	4	5	6	8	4	3	3	4	4	5	6	8	4	3	3	4	-36.975	-36.225
127	20	-36.6	215.133	191.9	4	5	8	8	4	2	3	3	4	5	8	8	4	2	3	3	-36.975	-36.225
128	82	-36.6	215.133	191.9	4	5	8	7	4	2	3	4	4	5	8	7	4	2	3	4	-36.975	-36.225
129	83	-36.6	215.133	191.9	4	5	8	7	4	2	4	3	4	5	8	7	4	2	4	3	-36.975	-36.225
130	125	-36.6	215.167	191.9	3	5	8	8	4	3	3	3	3	5	8	8	4	3	3	3	-36.975	-36.225
131	58	-36.6	215.167	191.9	3	5	8	8	4	2	3	4	3	5	8	8	4	2	3	4	-36.975	-36.225
132	10	-36.6	215.167	191.9	4	5	6	7	4	3	4	4	4	5	6	7	4	3	4	4	-36.975	-36.225
133	50	-36.6	215.167	191.9	3	5	8	7	4	3	3	4	3	5	8	7	4	3	3	4	-36.975	-36.225
134	7	-36.6	215.167	191.9	4	4	6	8	4	3	4	4	4	4	6	8	4	3	4	4	-36.975	-36.225
135	99	-36.6	215.133	191.9	4	4	8	8	4	2	3	4	4	4	8	8	4	2	3	4	-36.975	-36.225
136	100	-36.6	215.133	191.9	4	4	8	8	4	2	4	3	4	4	8	8	4	2	4	3	-36.975	-36.225
137	59	-36.633	215.2	191.867	4	5	7	8	3	2	4	4	4	5	7	8	3	2	4	4	-37.006	-36.26
138	106	-36.633	215.2	191.867	3	5	7	8	3	3	4	4	3	5	7	8	3	3	4	4	-37.006	-36.26
139	51	-36.633	215.2	191.867	4	4	7	8	3	3	4	4	4	4	7	8	3	3	4	4	-37.006	-36.26
140	114	-36.633	215.2	191.867	4	5	7	7	3	3	4	4	4	5	7	7	3	3	4	4	-37.006	-36.26
141	108	-36.633	215.167	191.867	4	4	8	7	3	3	4	4	4	4	8	7	3	3	4	4	-37.006	-36.26
142	91	-36.633	215.167	191.867	4	5	8	7	3	3	4	3	4	5	8	7	3	3	4	3	-37.006	-36.26
143	21	-37.6	215.167	191.9	4	5	7	7	4	3	4	4	4	5	7	7	4	3	4	4	-37.975	-37.225
144	11	-37.6	215.133	191.9	4	5	8	7	4	2	4	4	4	5	8	7	4	2	4	4	-37.975	-37.225
145	134	-37.6	215.167	191.9	3	5	8	8	4	3	3	4	3	5	8	8	4	3	3	4	-37.975	-37.225
146	124	-37.6	215.133	191.9	4	4	8	7	4	3	4	4	4	4	8	7	4	3	4	4	-37.975	-37.225
147	14	-37.6	215.167	191.9	4	5	7	8	4	3	3	4	4	5	7	8	4	3	3	4	-37.975	-37.225
148	64	-37.6	215.133	191.9	4	4	8	8	4	3	3	4	4	4	8	8	4	3	3	4	-37.975	-37.225
149	71	-37.6	215.133	191.9	4	5	8	8	4	3	3	3	4	5	8	8	4	3	3	3	-37.975	-37.225
150	5	-37.6	215.167	191.9	4	5	6	8	4	3	4	4	4	5	6	8	4	3	4	4	-37.975	-37.225
151	112	-37.6	215.167	191.9	3	5	8	7	4	3	4	4	3	5	8	7	4	3	4	4	-37.975	-37.225
152	66	-37.6	215.133	191.9	4	4	8	8	4	3	4	3	4	4	8	8	4	3	4	3	-37.975	-37.225
153	4	-37.633	215.2	191.867	4	5	7	8	3	3	4	4	4	5	7	8	3	3	4	4	-38.006	-37.26
154	102	-37.633	215.167	191.867	4	4	8	8	3	3	4	4	4	4	8	8	3	3	4	4	-38.006	-37.26
155	72	-37.633	215.167	191.867	4	5	8	8	3	3	4	3	4	5	8	8	3	3	4	3	-38.006	-37.26
156	18	-38.6	215.167	191.9	4	5	7	8	4	3	4	4	4	5	7	8	4	3	4	4	-38.975	-38.225
157	8	-38.6	215.133	191.9	4	4	8	8	4	3	4	4	4	4	8	8	4	3	4	4	-38.975	-38.225
158	74	-38.6	215.133	191.9	4	5	8	7	4	3	4	4	4	5	8	7	4	3	4	4	-38.975	-38.225
159	90	-38.6	215.133	191.9	4	5	8	8	4	3	3	4	4	5	8	8	4	3	3	4	-38.975	-38.225
160	131	-38.6	215.133	191.9	4	5	8	8	4	2	4	4	4	5	8	8	4	2	4	4	-38.975	-38.225
161	17	-39.6	215.133	191.9	4	5	8	8	4	3	4	4	4	5	8	8	4	3	4	4	-39.975	-39.225

Appendix O: 2-D and 3-D Renditions

The following figures comprise the three concept sketches (one per BCTC size) we constructed using MS Visio. Specifically, we constructed the actual building schematic in Visio and then imported that into MS PowerPoint in order to refine the sketch with visual representations of the TOC Pad area, etc. As the figures clearly show, the buildings are very similar in terms of the layout and are, in fact, scaled versions of each other (i.e., we scaled back the large to achieve a medium, and then scaled that back to achieve the small).

Large BCTC – Conceptual Rendition

Figure O. 1. MS Visio concept sketch of a notional prototype Large BCTC.

Medium BCTC – Conceptual Rendition

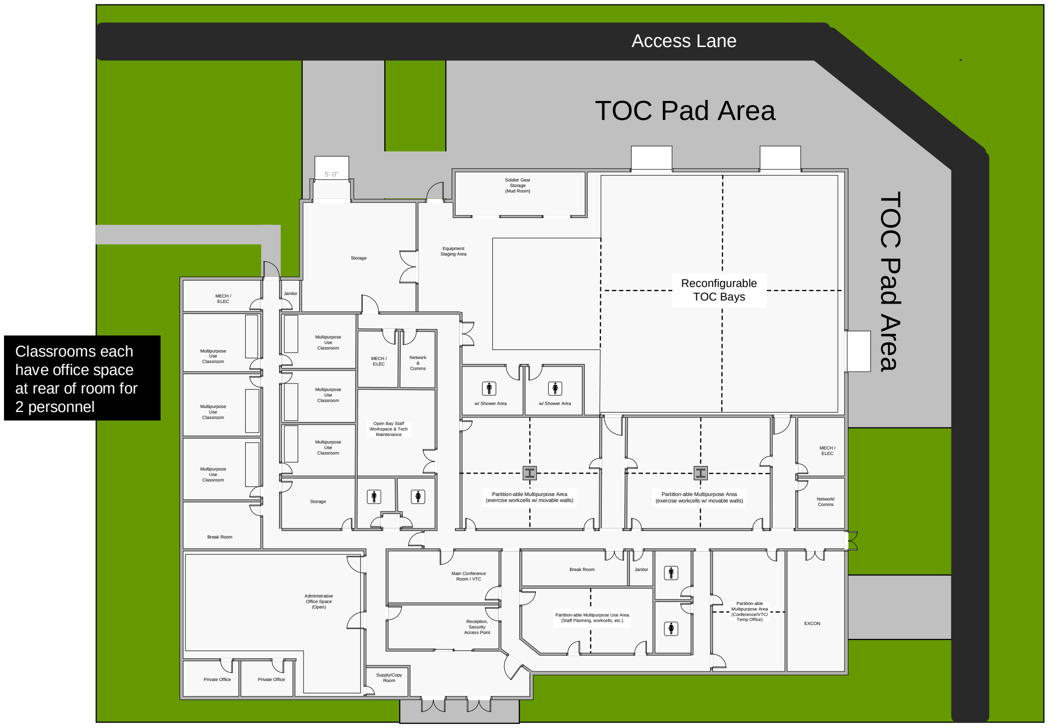


Figure O. 2. MS Visio concept sketch of a notional prototype of a Medium BCTC.

Small BCTC – Conceptual Rendition

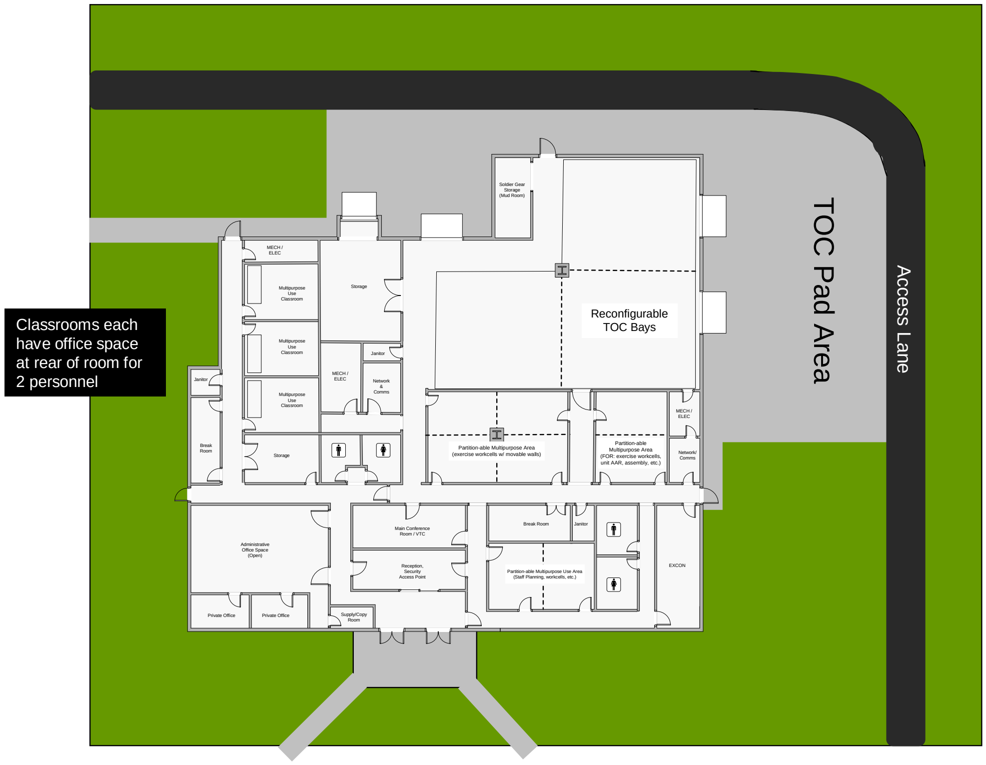


Figure O. 3. MS Visio concept sketch of a notional prototype of a Small BCTC.

The following series of figures consist of screen-shots of the 3-D fly-through rendition we created in Multi-Gen Vega Prime. The 3-D model is of a notional MEDIUM facility.

Figure O. 4. Front exterior view of a 3-D rendition of a notional Medium BCTC.

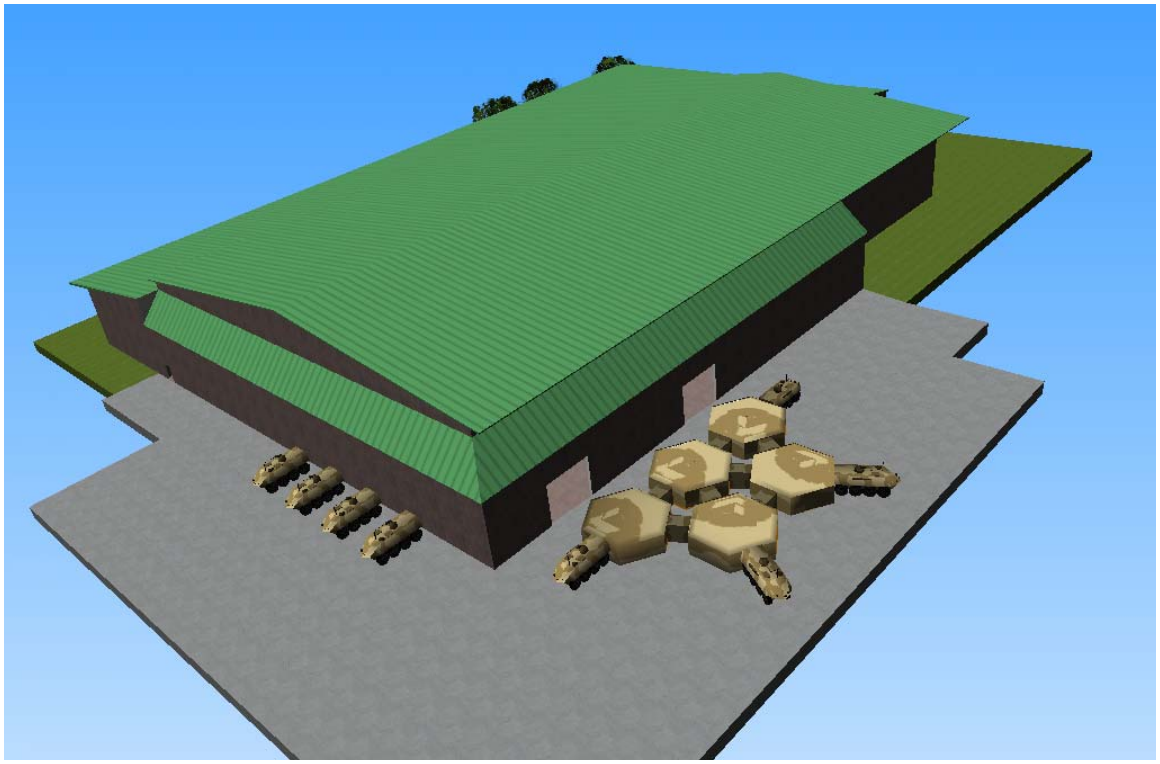


Figure O. 5. Rear exterior view (Brigade TOC on the TOC Pad, other vehicles "booted" and "wired" into the facility.

3)

Figure O. 6. Aerial view of interior (roof structure removed for clarity).

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14. ABSTRACT
This paper provides a detailed perspective on the problem-solving methodology used to develop a capabilities-based design template for the Army's future Battle Command Training Center. Central to this process was a simulation-based approach to evaluating the core capabilities of the BCTC and validating capability requirements for three facility sizes. Additionally, it will show how our efforts generated an analytical tool that the Army can use to assist in the design and development of training facilities to ensure they possess the capabilities required of them, as well as a simulation tool that can identify the potential impacts on training as a result of changes that run the gamut from space and staff levels to changes in training requirements to the unit composition on a particular installation.

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